

THE AGRICULTURAL LEDGER.

1898—No. 15.

BOEHMERIA NIVEA.

DICTIONARY OF ECONOMIC PRODUCTS, Vol. I., B. 576-606,
also Vol. VI., Pt. I. (Rhea), B. 172-213.]

RHEA (RIHA) OR CHINA-GRASS.

*Review of existing information on Rhea or China-grass being a Revision of
the account of that fibre as given in the Dictionary of Economic Products.
Also a Revision of the articles on Villebrunea integrifolia and Maoutia
Paya. By THE EDITOR.*

Other DICTIONARY articles that may be consulted:

Maoutia Paya, Vol. V., M. 260.

Villebrunea integrifolia, Vol. VI., Pt. IV., V. 133.

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INTRODUCTORY CONSIDERATIONS.

So much has already been written regarding the history and properties of the fibre known to Western Commerce as Rhea or China-grass, that it may seem superfluous to give another version of the old story. Indeed, it might be said of the past two centuries that, as one rhapsody has followed another, the fibre has assumed a more and more mythical position. That it possesses intrinsic merits of a high order cannot be questioned. That it is likely in the immediate future to become one of the great staples of the world's commerce would appear to be open to grave doubt. Had the fibre been easily separable and had its production been possible on a large scale, it would no doubt have long ago secured the attention necessary for participation in the early developments that stamped the 18th and 19th centuries as pre-eminently those of manufacturing progression. The ease with which cotton lent itself to Western necessities and the abundance and cheapness of the supply, left little room for rhea. The Western textile markets have been allowed to become established

INTRODUC-
TION.

AN OLD STORY.

INTRINSIC
MERITS.

DIFFICULTY OF
SEPARATION.

LIMITED
PRODUCTION.

FUTURE
PROSPECTS.

B. 576-606: R. 172-213.

SCHEMRIA

Introductory Considerations.

Notes.

**INTRODUC-
TION.**

**Machinery
Required.**
Conf. with
Genl. G.S.
72, 81, 87,
100, 226-5.

**Position of
the Fibre.**

**Attitude
of the
Manufacturers.**

Production.

Rhea Market.

**Attitude
of the
Producer.**

without a place having been secured for this fibre. In consequence, its prospects might almost be regarded as even less to-day, than they were a century ago.

2. Opposition to Rhea Industry.—Speaking generally, it may be said that rhea cannot be worked on cotton machinery, though a modification of the Ring Spinning Frame may be used. From a spinner's point of view rhea is more akin to waste silk or wool, and in other respects to flax or jute than to cotton. But it seems doubtful if it can be satisfactorily spun on the machinery employed for any one of these fibres. In the various stages of its manipulation special adaptations have been found desirable and, in consequence, new factories and special machinery are indispensable to the organisation of a rhea-spinning business. Indeed large sums have been spent in bringing even to the present state of perfection the spinning machinery employed.

The manufacturers have thus by no means been neglecting their side of the enquiry. The building of factories and the equipment of special appliances are not, therefore, insurmountable obstacles, but, it is possible, they represent more correctly the want of progress that has marked the past half century than the defect of not possessing a cheap and effectual fibre-extracting machine can be supposed to do.

3. Supply and Demand.—Were a steady demand to arise in Europe for the fibre, production would instantly respond. The obstacles that exist to the preparation of a clean fibre would rapidly vanish, indeed they may be said to have disappeared very largely already. What is wanted is a remunerative demand. Let the manufacturer satisfy himself that there is a distinct market for rhea textiles, and in consequence let him give a guarantee to the producer, and the difficulties that beset production will cease to exist. As matters stand at present, the manufacturer says—I have not obtained the assurance of a continuous sufficient supply to justify me in building a special factory for rhea. The producer responds—that is precisely my difficulty. The fibre has not as yet secured a definite position, the market is accordingly small and I am in your hands to receive for my produce what you choose to pay.

4. Position of Rhea in the Scale of Textiles.—This is so imaginary picture. It presents very closely the actual position of

High Price Essential.

(G. Watt.)

SCINMERIA
niva.

others. In consequence the pioneer manufacturer very possibly may himself have to become the producer until he has securely fixed the position of rhea. At all events past experience would seem to point conclusively to the necessity of some idea being given to the European planters and Native cultivators, as to the margin of profit that is likely to fall to them. It has, accordingly come about that it is not a question of what is the lowest price at which it can be produced? It is much more—what is the highest price that the fibre is likely to secure.

The Indian cultivator is by no means so hard pressed in his choice of crops that he need turn attention to rhea. And this fact cannot be too urgently brought to the knowledge of those who would look to India for a commercial supply. The effort must be made to secure a fixed and definite position for rhea in the scale of textiles in which the price (in relation to its admitted valuable properties) would be raised rather than lowered. To attempt to place it on the agriculture of the tropics as an article to be employed in admixture or substitution is to court failure. I most completely therefore concur with Mr. Charles Richards Dodge, of the United States Department of Agriculture, that the—

"Facility to imitate all other textiles is one of the principal causes which has kept back the development of the ramie industry; and if, instead of launching out into a series of experiments, attention had been concentrated upon the exclusive manufacture of those articles to which the properties of the plant were peculiarly and naturally adapted, this industry would probably be in a more advanced condition than it is at present. The folly of building up a ramie manufacturing industry on a false basis, that is, employing the textile as a substitute for something else is to be deprecated. The fibre should be used in those articles of economic necessity which would appear on the market as ramie, that any distinctive merits the textile may possess will become known, not only to the ramie trade, but to consumers of the produce."

It is only by pursuance of a policy, such as Mr Dodge advocates, that a fixed position can be secured and the price raised to a standard relative to its intrinsic merits and properties. If the manufacturers are not prepared to fight for a high instead of a low position, the production of this fibre will remain for many years to come in its present position.

TEXTILE
POSITION.

Price (likely
to be
Secured.

Choice
of Crops.
(Conf. with
para. 48. d,
54.

Definite
Position for
Rhea.

A False
Basis.

Price in
Relation to
Properties.
(Conf. with
para. 196.

**SCHEMRIA
RHEA.**

Introductory Considerations.

**INTRODUC-
TION.**

**Misconcep-
tions.**

*Conf. with
para. 117.
Comparison
with Jute.*

**Jute in
1866.**

*Conf. with
para. 25,
46, 84, 124.*

**Present
Position of
Jute Trade.**

**Rhea made
known to
Dundee in
1853.**

**Great
Stumbling
Block.**

**Rhea is not
Indigenous
to India.**

*Conf. with
para. 4-7,
17, 28, 30,
35, 41, 44,
62, 66, 77,
86.*

5. *Misconceptions.*—To talk of rhea competing with jute or even cotton is ridiculous. But the wildest conceivable hallucinations have disfigured the literature of this fibre, and perhaps none more delusive than the statement that rhea would drive jute out of the markets of the world. When silk is thought of as a substitute for jute then and only then need rhea be entertained as a rival for a fibre, the chief merit of which is that it is one of the cheapest of all known textiles.

Dr. Buchanan-Hamilton wrote of jute in 1868 :—

"Whether or not this plant might be employed in Europe to make cordage or canvas, I cannot say; but I hope, that no circumstance will divert the attention of the public, until a fair trial has been made with *Senn* (*Crotalaria juncea*), which, I have no doubt, will be found to answer just as well as European hemp."

It is hardly necessary to contrast with the above opinion the actual production and manufacture that now represents the industrial value of jute to India. The first recorded exports of that fibre from India to England, occur in the return for 1828. Since then jute has become, after cotton, the most important textile of India, while hemp and rhea are in the precise position they occupied during the first decade of the century. We have to thank Dundee for this result—a result the more surprising since, while jute was but in its infancy (1853), the merits of rhea were urged on the attention of the Dundee manufacturers to no purpose.

6. But to return to the subject of the misconceptions that prevail regarding rhea, there would seem to be no doubt that the assurance of the inventors and owners of fibre-extracting machines, has been one of the great stumbling blocks in the progress of rhea. Each new invention or process has practically been heralded by two statements variously expressed :—

(a) Rhea is in India a wild plant which may be easily cultivated and the fibre placed on the market for little more than the cost of collection.

(b) With the advent of this invaluable discovery there can be no doubt that henceforth rhea will make rapid strides toward becoming one of the most important of all known textiles.

The latter statement I pass without comment, but I desire to record the most emphatic protest against the former.

7. *Rhea not Indigenous to India.*—*Precision.*—This is no India, nor even an acclimatised wild rhesely the actual position of
B. 576-606.

Cultivation and Fibre Production.

(G. Watt.)

SCHEMERIA
nivea.NOT
INDIGENOUS.

has attended its acclimatisation that it nowhere exists as an escape and serves in neglected cultivation for only a very few years. As examples of misconceptions of this nature, I may quote the following:—

“No difficulty in obtaining ample supplies has ever been anticipated, for the plant is, practically, a weed in China and India, and can be grown in any warm climate” (*The Economist*, July 27th, 1845.)

A pamphlet issued with Mr. D. Edwards Radclyffe's compliments assures its readers that—

“The weed resembles somewhat the raspberry cane, and grows, we are informed by those who take an interest in it, over the wide world.” In the “*Drapet's Record*,” we are informed, “It flourishes—almost as freely as the weeds in our gardens—in all tropical and semi-tropical climates, agriculturists in Java regarding it with about the same ‘respect’ as the British farmer does the nettle, to which family it really belongs. It grows like a raspberry cane, but is not prickly.”

The comparison to the raspberry bush is just about as accurate as the statement that it is an abundant weed in the tropics. It occurs in this country purely and simply in a state of *garden not even field* cultivation, and cannot be made to give a crop unless liberally manured.

Although it may be grown as a garden curiosity all over India and Burma, it is not cultivated by the people of India as a fibre plant anywhere, except in some half a dozen districts of Northern Bengal, throughout the greater portion of the valley of Assam, and in the Shan States of Burma. Experiments have been made by Europeans in other localities, and these so far have confirmed what is practically the experience in Europe, Australia and America, that there is a vast difference between the cosmopolitan endurance of the plant, and the degree of luxuriance essential to its production as a fibre crop. The only exception to this statement may be said to be the comparative success that has attended its cultivation in Kangra.

8. *Cultivation and Fibre Production.*—Linseed is grown all over India and is one of the most important of crops, but it is well known that, in spite of the large sums expended by Government and the fortunes lost by planters, in the endeavour to produce flax we have failed to do so. The same remark is true of hemp. It is a valuable crop in many parts of the plains, yielding the narcotic, but except in the North-West Himālaya it nowhere else affords a useful fibre in its stems. The ease with which linseed,

Is a Garden
Crop in
India.Conf. with
para. 22,
25, 41, 48,
53, 101.Extent of
Possible
Cultivation.Present
Cultivation.Cosmopolitan
Endurance.Flax
Production
in India.Hemp
Production.Conf. with
para. 40.Production
of Fibre
Restricted.

BOEHMERIA
given.

Introductory Considerations.

HYPOC-
YSS.

Price.
Conf. with
paros, & d.
54, 55, 56,
57, 58, 59-61,
102, 100,
100.

Bengal
Prices
224 to 234
a ton.
Conf. with
paros,
104-6.

London
Prices 235
to 250 a ton.

Allied Plants
to Rhea.

hemp, and rhea may be grown anywhere in India is, therefore no proof that they can be made to produce fibre commercially. Were it otherwise, the very natural question would at once occur—in the case of rhea—Why has the production of the fibre not become diffused throughout the country?

9. *Local Production and Price.*—So far as Bengal is concerned, rhea cultivation is confined at the present moment to a few districts, and probably to the identical villages within these in which Dr. Buchanan-Hamilton found in 1807. It has made no progress whatsoever, and yet the fibre sells locally at a price that one might infer should have tempted an extended cultivation. It is the most expensive of all fibres in the districts where it is found. The supply, judging from the information derived by me from the cultivators, would appear to hardly equal the demand, hence the prices were found to vary from village to village in the most erratic manner. The crudely cleaned and unbleached fibre was nowhere procurable at a price below eight annas a seer (2½), and at that only in small quantities, the usual price was from Rs 1 to Rs 2.8-0 a seer. But I may here mention an actual transaction. A maund of unbleached China-grass was purchased (25th October 1895) by the Collector of Rungees on behalf of my office, and the price charged came to Rs 4-5-0 a seer. That is to say, at the rate of exchange of 12. 4d. to the rupee, the Bengal local price averages roughly from £36 to £180 and £324 a ton for hand-cleaned China-grass.

During the discussion of a paper read before the Society of Arts. (2nd April 1897), by Mr. Thomas Barraclough, one speaker said the price of China-grass in London had gone up to £35; another mentioned that he knew of contracts made recently at £15 to £16; while a third referred to a purchase made that week at £27 a ton. If these prices are to be accepted, it may be admitted that China-grass sells in India at a price higher than in London, so that, instead of exporting, India should in reality be importing the fibre to meet a remunerative demand.

10. *Other Rhea-like Fibres.*—But while rhea is not a native of India, there are some ten species of plants that belong to the same genus (*Boehmeria*) that are indigenous, and some of these are extremely plentiful and widespread. The family resemblance to the rhea plant (*B. nivea*) of most of these, is very generally recog-
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Other Rhea-like Fibres.

(G. Watt)

BOEHMERIA
nivea.

named by the people and one or two, more especially *B. platyphylla*, are spoken of as *ben* (wild) *riha*. But it is somewhat significant that none of the indigenous species of *Boehmeria* are known to the people of India, generally, as affording useful fibres. In one instance, I was assured that when cultivated *Boehmeria platyphylla* gave a fibre, but I nowhere found it either cultivated or its fibre being extracted. Indeed, as the result of recent personal explorations, I began to suspect that a mistake may have been made by some of the earlier writers, who speak of the wild *Boehmerias* of India, as yielding fibres. I have scraped the stems of most of them and failed to find sufficient fibre to justify the benefit of the doubt being given, that they may be viewed as fibre-yielding plants.

On the other hand, there are three or four species of indigenous nettles all more or less allied botanically to the rhea, but which are not species of *Boehmeria*, that are well known to yield valuable fibres. One of these is by the hill-tribes of Assam universally designated the *ben* (or *ben*) *riha*. They admit that *Boehmeria platyphylla* is a *ben-riha*, but the plant to which I here alluded, *vis.*, *Villebrunea integrifolia*, they distinguish as the true *ben-riha*. This yields a fibre of great merit to which I propose to allude in some detail further on.

Then again from the Khasia Hills and along the foot of the Himalaya from below Darjeeling to Nepal and Garhwal, there occurs another fibre-yielding nettle that even more closely resembles the *Boehmerias* than does *Villebrunea*. This is known as the *poi* or *pya* (*Maoutia Puya*), but the fibre which it affords is, I believe, comparatively worthless.

From time to time both these stingless nettles, which in that respect may be designated *Boehmeria*-like nettles, have occasionally but incorrectly been spoken of (by European writers) as wild rhea and, in consequence no doubt, has crept into existence the absolutely erroneous opinion that the rhea was a native of India, because it had been affirmed it existed in its wild state all over the country. To this circumstance may also be attributed the reputation given to some of the indigenous *Boehmerias*, *vis.*, that they afford useful fibres.

In addition to the two wild *Boehmeria*-like fibre-yielding plants just mentioned, there are two more species that may be here alluded to briefly. These belong more correctly so speaking to the nettle

NETTLE
FIBRE.

Ben or Wild
Boehmeria
Conf. with
papa. 22,
76-77, 82

Other Sting-
less Nettle
Fibres.

Ben-riha.
Conf. with
papa.
199-200.

Puya.
Conf. with
papa.
111-226.

Stinging
Nettles.

**BOEHMERIA
NIVEA.**

The Chinese Plant.

INTRODUCED
FROM
Burma.

Burm. Burm.
Conf. with
para. 77.

family (or stinging nettles) and both yield well known fibres. There are the *rural* or *cherpalla* of Bengal or the *sir-nal* of Assam (*Laportea crenulata* *) and the *horn rural* of Assam (*Girardinia heterophylla*). The last-mentioned may possibly be the *menilibe* fibre referred to Major Hannay and some of the earlier writers on the subject of the Assam nettle fibres.

While these stinging nettles are met with within the area of rhea cultivation, more especially on the lower hills, they are only rarely confused with rhea, and for the purpose of the present paper may, therefore, be dismissed with the remarks already offered.

11. Having thus very briefly set forth some of the practical results and conclusions arrived at during a recent exploration of the Indian areas of rhea fibre production, it seems desirable that I should now endeavour to furnish as complete a review as possible of the available information regarding this much-hackneyed subject. In doing so I shall throw the material that has been accumulating in my office for the past few years, into the form of a revision of the articles as published in the Dictionary of Economic Products on *Boehmeria nivea*, *Villebrunea integrifolia*, and *Maoutia Puya*.

THE CHINESE AND INDIAN PLANT.

1. *Boehmeria nivea*, Gaudich., *Bot. Freyc. Voy.*, 499; (*Excl. Syn. Ramium majus*, Rumph.); *Fl. Br. Ind.*, V., 575; URTICACEÆ.

RHEA, CHINA-GRASS.

12. *Syn.*—*Plukenet*, *Amalt.*, p. 212 t. 449, f. 2, (1703 AD); *Koempfer*, *Amoen. Exotic.*, p. 891 (1712); *URTICA NIVEA*, *Linnaeus*, *Sp. Pl.*, 1398 et *Hort. Cliff.*, p. 440, No. 4 (1757); *Burmah*, *Flora Ind.*, p. 107 (1768); *Thunberg*, *Flor. Japon.*, p. 71 (1784); *Loureiro*, *Flora Coch.*, pp. 558-9 (1790); *U. NIVEA*, *Willd.*, *Buchanan-Hamilton in Stat. Account, Dnyapur* (written 1809, republished 1833), 194, 201; *BOEHMERIA* (*PROCRIS*) *NIVEA*, *Gaudich.*, *Bot. Freyc. Voy.*, pp. 499-500 (1826); *Hooker & Arnot*, *Voy. Beech*, p. 214 (1841); *Voyt.*, *Hort. Suburb. Calc.*, 280; *Fortuna*, *Three Years' Wanderings in N. China*, p. 53 (1847, also *Specimens collected by him in Herb. Bot. Gardens, Calcutta*); *Macgowan*, *Jour. Agri-Hort. Soc. Ind.*, Vol. VI., pp. 209-19 (1848); *Hooker*, *Journ. of Bot.*, I., 25, 159 (1849); *Blume*, *Mus. Bot. Lugd. Bat.*, II., pp. 210-11

BOTANICAL
LITERATURE.
Conf. with
paras. 25
and (Com-
moned) 26

* Masters gives an interesting account of the stinging property of this plant in *Jour. Agri-Hort. Soc. India* (1848), Vol. VI., pp. 44-45.



BOEHMERIA NIVEA

LESLIE, D. J. C. 1904

Probable Derivation of the Name.	(G. Watt.)	BOEHMERIA nivea.
(1849-56); <i>Miquel, Plant. Jugh.</i> , p. 33 (1850); <i>Hooker, Journ. of Bot.</i> , III., pp. 312-16, Pl. VII. (1851); <i>Waddell, Mon. Fam. des Vert.</i> , pp. 380-82 (in part) t. XI. f. 10-1 (1856); <i>Wight, Icon. t.</i> , 688; <i>Bentham, Flora, Hongkong</i> , 331 (1861); <i>Miquel, Flora Japon.</i> (1867); <i>Waddell in DC. Prod.</i> , XVI., Pt. I., 206 (1869); <i>Brandis, For. Fl. N.-W. P. and C. Ind.</i> , 401 (1874); <i>Baillon, Nat. Hist. Plants</i> , Vol. III., 503 (1874). (<i>Ensl. engraving n.</i> , 341).		CHINESE PLANT.
<p>13. <i>Fernacular Names.</i>—In modern commerce RHEA appears to have been ascribed to the decorticated ribbons and CHINA-GRASS assigned to the unbleached though more or less cleaned fibre. Rhea (or <i>Rika</i>, <i>Rika</i> as it should be written), being the Indian name for this plant, might with advantage be given to the Indian produce, and <i>Rami</i>, being the Malayan name, might be restricted to the variety dealt with below, or at all events to the produce of the Malay Archipelago. In other words, it seems to me an error, not only in fact but very possibly in the textile merit of the products concerned, to speak of the Indian and Malayan fibres as Rhea or Rami. These names are neither synonymous nor are the fibres in all probability derived from the same plant. It would be more in accord with the actual state of affairs to speak of Rhea and China-grass conjointly but distinct from Rami or Ramie as it is sometimes written.</p> <p><i>Chu-ma</i> (<i>ichou-ma</i>) is the Chinese name for the plant. <i>Cay-gai</i> and <i>Pa-ma</i> are given to it in Cochin China. <i>Kankhura</i> (or rather <i>Kantura</i>) is its most general Bengal name, but in Bogra it is called <i>Kand</i> and in some parts of Jalpaiguri the name <i>Kurkunda</i> is given to the plant. <i>Recha</i> (<i>Rika</i>) is its Assami name and <i>Risa</i>,* <i>Rusa</i> and <i>Samsa</i>, were given me as Naga names for the plant. In the lower portions of the Valley of Assam such as at the foot of the Garo Hills and in Kamrup, generally it is known by its Bengali name <i>Kankhura</i>. It is <i>Pan</i> in the Shan States and <i>Gun</i> † or <i>Gwon</i> in Burma.</p> <p>14. In Assam no cultivator would recognize the word rhea. It is <i>rika</i> i. e. pronounced <i>ree-ha</i>. The ladies of that Province wear a light muslin shawl thrown across the shoulders. This is the <i>rika</i> or breast cloth—a garment supposed to protect the heart. An intelligent Assami gentleman, with whom I conversed in Golaghat, derived the name <i>rika</i> from the Sanskrit <i>hrīd</i>—the heart—but, as opposed</p>		<p>Commercial Names.</p> <p>Ribbons. Conf. with para. 62, p. 50-B.</p> <p>Chinese Name.</p> <p>Indian Names.</p> <p>Rika Shawl Conf. with para. 77, p. 50.</p>

* See Naga names for Villiebrunsa, para. 192.

† See Malay name, para. 26.

BOEHMERIA
nivea.**The Chinese Plant.****CHINA**
PROV.:
SENA.**Sense.****Rhea never**
woven.**Native Fibres**
woven.**Villebrunea.**
Conf. with
para. 10,
16, 77, 106,
200-210.**Probable**
Origin of
Rhea and
Non-rhea.
Conf. with
para. 202.

to that view, it must be added that at the present day at all events the *riha* shawl of the Assamese ladies is not made of China-grass. It is mostly a silk gauze or a mixed silk and cotton gauze or by the poorer classes unbleached cotton gauze. In every instance, however, it is a fabric woven in the peculiar manner best described by the term gauze, and it most unquestionably recalls the appearance of the fine grass cloth muslins or gauzes of China.

At Gauhati I was assured by an Englishman of long acquaintance with Assam and its people that the Assamese undoubtedly made the muslin from the *riha* fibre. I was greatly surprised and interested at this piece of information, since, so far as my experience went, both in Bengal and Assam the fibre is employed exclusively in the manufacture of fishing lines and nets. Accordingly I asked my informant to be good enough to procure for me a few samples of *riha* shawls. The result was an extensive assortment of the gauzes mentioned above, not one of which contained a trace of rhea fibre. Indeed this may be said to be one of the most surprising features of the *riha* or *lassura* industry of India, viz., the fibre is nowhere woven into fabrics.*

But on turning attention from the plains of Assam to the adjacent hills, the various tribes that inhabit these wild countries are found to regularly manufacture cloth from one or two of the wild netles mentioned above. The Jakhia Nagas, whom I visited in connection with the enquiry into this fibre, grow *Boehmeria nivea* and sell the produce to the people of the plains; they call it *riha* or *rusa* (Conf. with para. 191). Their locally produced fabrics are chiefly woven from cotton yarns imported from the plains or from the *ban-riha* fibre—*Villebrunea integrifolia*. In the Angami Naga country they use both *Villebrunea integrifolia* and *Girardinia heterophylla* but do not cultivate the *riha*. It is not my purpose to deal here with these rhea-like fibres, and I would therefore conclude the present remarks regarding the names given to *Boehmeria nivea* by offering the suggestion that, since the family resemblance between the two (*Villebrunea* and *Boehmeria*) seems fairly generally recognised, it seems probable that *Villebrunea* is the original *riha* of Assam.

* See remark, para. 54, about its having been used in Bhagalpur to mix with silk, also Mr. Lloyd's account of the uses of fibre of *Villebrunea*, para. 204.

† May not the word *riha* have been derived from the Naga names *riha*, *rihaa*, the letters "s" and "h" being interchangeable? See Mr. Severn's account of *Villebrunea*, para. 207.

Citation of Books and Collections.

(G. Watt.)

BOEHMERIA
nivea.

and that on *Boehmeria nivea* being carried across the Chinese frontier and introduced to the cultivators of the plains, it was called *rhe*, and the wild plant then became spoken of as the *Ass* (wild) *rhe* or *rin*. Be that as it may, it is to say the least of it remarkable, that the aboriginal tribes have fully appreciated the properties of the *Ass-rhe* and been able to spin and weave it, while their more enlightened neighbours of the plains can only spin the *rhe* into string and make fishing nets from it. This circumstance would seem to indicate a greater antiquity for the knowledge of the textile properties of the wild as compared with the cultivated plant.

15. *Description of the Plant*.—It is perhaps hardly necessary for me to repeat all the descriptive details given by the majority of the botanical writers whose works have been cited above. It will serve the purpose of this paper to confine attention to a few of the more diagnostic—those in fact that may be regarded as separating the typical form of the species, from its variety described below.

It is a herbaceous, sparsely branched plant, with thick succulent, velvety hairy stems. *Leaves* broad ovate, the apex acuminate, the margins coarsely dentate-serrate, and the base truncate and only slightly drawn out into the petiole, but hardly ever showing any tendency to be cordate. The veins on the lower half of the leaf are distinctly three, the midrib becoming pinnate above the middle. Under-surface felted uniformly all over with silvery wool in which only the midrib and the primary (or at most the secondary) veins show through the felted surface and bear scattered thick, hyaline hairs. *Stipules* large and persistent. *Inflorescence* mostly much shorter than the petioles, thick and crowded with clusters of flowers.

16. *Citation of Books and Collections*.—In the above enumeration of authors I have endeavoured to cite all the more important botanical works that describe what may be taken as the typical condition of the species. As far as possible they have been mentioned in the sequence of date of publication and two of the writers—Fortune and Maogowan—have been classed as botanical authors on account of the specimens they collected being in the Herbarium of the Royal Botanic Gardens, Calcutta. I would here desire to mention that I am satisfied the two conditions of the species

CHINESE
PLANT:
CHINA
GRASS.Diagnostic
Characters.
Conf. with
Variety,
para. 17.Limits of
Variation.
Conf. with
para. 16.Fortune and
Maogowan's
Chinese
Collections.

**BOEHMERIA
nivea.****The Chinese Plant.****INDIAN
PLANT :
RHEA.**

which have been recognised alike by botanists and cultivators, are but geographical varieties. As a matter of convenience accordingly I have referred all writers on the Chinese plant to this position and transferred those on the Malayan to the variety, even when I have not found their descriptions to fully bear out that isolation. The two plants are so very similar that the descriptions and even the illustrations given by the earlier authors might be placed under either form.

**Dr. William
J. Hooker's
Account of
the Plant.**

The earliest published illustration that could be said to be unmistakably *Boehmeria nivea* is that given by Sir W. J. Hooker in the *Journal of Botany* (Vol. III, table viii.). I have ventured to reproduce that plate in connection with this paper, partly because it has already been given by Dr. Forbes Watson and other economic writers, and is thus prominently associated with all that has since been written on the subject, but mainly because it is a faithful representation of the plant. The leaf outlined below the twig (see Plate I.) shows the typical condition of the base of the full-grown leaf—not at all cordate, but with a very slight prolongation into the petiole. In young leaves a more or less cordate condition may be seen, but this disappears as the leaf expands.

Plate No. I.**Roxburgh's
Drawing and
Description.**

Roxburgh's unpublished coloured drawing [the original of which is in the Herbarium, Calcutta (Vol. XIV, No. 59), and a copy of which is in the Herbarium of the Royal Botanic Gardens, Kew] is an illustration, as I take it, of the typical form of the species, and not of *Urtica tenacissima*—the form described by that author in the *Flora Indica*. Roxburgh's drawing has, however, been published by Wight (*Icon. Pl.* t. 686) and by many subsequent writers on Rhea as an illustration of *B. nivea* var. *tenacissima*.

**Wight's
Illustration.****Is a Native
of China.**

17. *Habitat*.—There would seem to be no room for doubt that the typical form of the species is a native of China. It is widely distributed throughout that country as a cultivated plant and has been repeatedly mentioned as having been collected in a wild state. According to Benthham it was found by Champion abundantly in the ravines of the island of Hongkong. It is cultivated in the Straits Settlements, possibly also in the Malay Archipelago, in Japan, Formosa, the Philippine Islands, Burma, India, Australia, America and Europe. This is in fact the chief cultivated condition of the species, but I have neither seen a specimen of it recorded as a wild plant, nor have I discovered

**Wild in
Hongkong.
Cult., with
various, 54,
55, 56.****Area of
Cultivation.****B. 576-606.**

Habitat.

(G. Wall.) BOEHMERIA
nivea.

a writer who could be regarded as speaking of it as found in a wild state, anywhere except in China.

Mr. O. B. Clarke, in a letter addressed to the Secretary, Government of Bengal (16th June 1870), would appear to have viewed the variety *tenacissima* as the cultivated state of the species, and the fact of its not producing seeds, he suggested, "is very strong against its existing in a wild or semi-wild state in Bengal." Further on in the same letter, however, he adds "*Boehmeria nivea* has been found perfectly wild in Upper Assam and Burma, and I believe I saw it myself wild in the Chittagong Hills." "It has frequently been said that it grows wild in Nepal and Sikkim, but I never could find it here (Sikkim) myself nor have I ever seen a specimen." It is of course scarcely fair to Mr. Clarke to quote an official letter, written nearly 30 years ago, as expressing his present opinion. I have quoted the above passages from his letter as a type of the views currently held at the period in question. So in a like manner in the Kew Bulletin (1888, p. 146) the following passage occurs: "A plant, called in Assam Rhea, and in the Malay Islands, Ramie, was believed by Roxburgh to be distinct from the Tchou Ma of the Chinese, and it was named by this botanist *Boehmeria (Urtica) tenacissima*. In this plant there is an absence of the white-felted appearance, on the underside of the leaves, so characteristic of the China-grass plant." These passages may be accepted as fully justifying the statement (developed in further paragraphs) that until very recently the two forms had not been separately recognised by Indian botanists, and further that no definite information existed as to which form was actually being cultivated by the people of India. I need hardly repeat, however, that the silvery white-leaved plant is the only one met with in cultivation in India. The wild plants recorded from Japan, Formosa and the Malay Archipelago, I believe to be quite distinct.

18. In the Calcutta Herbarium Fortune's specimen (No. 281) is stated to be the wild plant. He tells us it was collected at Chekiang. It preserves in a remarkable degree the chief peculiarities of the cultivated state except that the leaves are smaller, the stems thinner and more woody, than in the cultivated plant (his No. 280). One is quite prepared accordingly, for the remark made both on the label attached to the specimen and in his *Three Years' Wanderings in N. China* that "the wild variety is worthless" as a source of fibre.

CHINESE
PLANT:
CHINA:
GRASS.Mr. C. B.
Clarke's
Opinion.Conf. with
para. 228.Does not Pro-
duce Fertile
Seed.Conf. with
paras. 22,
27, 29, 28,
112, 147,
178.Reported to
be Wild in
Assam and
Burma.Conf. with
paras. 6-7,
22, 26, 28,
212.Variety
tenacissima
believed to
be Grown in
Assam.Imperfect
Information
regarding
Indian Form.Conf. with
paras. 19,
27, 28.Specimens in
the Calcutta
Herbarium.The Wild
Plant from
China.Conf. with
paras. 29,
also 17, 24,
26, 28.

•R. 172-213.

**BOEHMERIA
nivea.****The Chinese Plant.****BOEHMERIA
nivea.****Dr. A. Henry's
Collection.****Samples by
Mr. Hooze
from
Wenchow.****Plants Escap-
ing from
Cultivation.
Conf. with
para. 22.****Silvery To-
mentum of
Under-sur-
face is
Modified.
Conf. with
para. 17,
26, 28.****Boehmeria
platyphylla.
Conf. with
para.****Neither Wild
nor an Accli-
matised
Wood.****Does not
Survive when
Abandoned.
Conf. with
para. 26,
28.**

Dr. Macgowan sent specimens from China in illustration of his paper on "China-grass," and he informs us that "it grows on the walls of Ningpo." It is somewhat curious that Linnaeus gives very nearly the same remark, namely, that it grows on walls in China. But in the *Hort. Cliff.* he makes the still more curious observation that it is a plant which has the appearance of being American. Dr. A. Henry's specimen (No. 4878) collected in 1885-88 in Central China is quite typical. I have had the pleasure to receive an admirable set of botanical samples of the plant contributed by Mr. Hooze, Her Britannic Majesty's Consul at Wenchow, and these fully bear out the peculiarities of the species indicated above. But I may here mention that Mr. A. Hooze in forwarding these specimens made the following very instructive remark, "Now, although only one form of *Boehmeria* is cultivated round Wenchow (*B. nivea*), I notice that this plant as soon as it strays from cultivation, as where seeds have been carried by the wind into loose stoney walls or on to poor soils, the silvery-white under-surfaces of the leaves quickly disappear and give place to green with white or rather flesh-coloured veins, while the stems assume a brownish colour." In neglected cultivations in India the leaves become smaller, thinner and the silvery tomentum much less dense but I never witnessed it to have entirely disappeared and given place to a green texture with coloured veins. Practically everywhere in India where *B. nivea* is cultivated, *B. platyphylla* occurs as a weed around the rhea enclosures. In that species the leaves are green below with the veins often pink and in point of shape they are by no means unlike the leaves of badly grown rhea. Indeed the cultivators in most parts of India call that species "wild rhea" though the two plants have nothing in common; certainly the one could in no way be derived from the other. I have ventured to make these observations with regard to *B. platyphylla* with a view to guard against any possible misapprehensions as to the recognition of supposed wild rhea or rhea that was presumed to have escaped from cultivation. So far as India is concerned, *B. nivea* neither exists as a wild plant nor as an escape from cultivation, and will only survive for a few years on being abandoned. Moreover, all the herbarium specimens seen by me that had been collected in China have manifested in a remarkable degree of constancy the condition of the species indicated above. In fact I have practically met with no instance, among

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Plant most with in India.

(G. Watt.) BOEHMERIA
nivea.

a wide series of any very distinct tendency to approach the Sumatran form, though in cultivation I believe hybrids are by no means rare.

19. *Plant most with in India.*—Turning now to India it may be matter of surprise to many to learn that the cultivated plant of to-day in this country, from one end of it to the other, is the Chinese and not the Malayan form as here defined. In the Calcutta Herbarium there is an interesting series of specimens of which I may mention the following:—*Wall. Cat. No. 4606 A*, collected at Rugganj on and December 1867. In passing it may be here remarked that *Wallib* in a letter to the Secretary, Agri.-Horticultural Society of India, dated September 7th, 1836, identifies samples of Assam rhea that had been furnished by Captain Jenkins as *Urtica nivea* and speaks of the plant as growing in the Botanic Gardens alongside of similar shrubs from the Malay Archipelago.

Dr. Campbell's so-called *Poa* fibre plant from Darjeeling, of which he wrote in the Agri.-Horticultural Society's Journal (1848), Vol. VI., pp. 135 and 240, is not *Maoutia Puya* as supposed at the time, but typical *Boehmeria nivea*. Mr. C. B. Clarke has very properly noted on the sheets in the Calcutta Herbarium that they are not *Poa*, and it is significant there are no specimens from Dr. Campbell under the cover of *Maoutia Puya*. Both Jenkins and Masters contributed samples from Assam, the latter in 1845. But in no instance is there the slightest indication that any of the Indian specimens had been collected from wild plants. In my own herbarium (and as the result mainly of personal explorations) I have the plant from Dinajpur, Rungpur, Jalpaiguri, the Duars, Kuch Behar, Bogra in Bengal; from Kamrup, Nowgong, Darrang, Sibsagar, Lakhimpur in Assam; from Kangra in the Panjab; and, through the kind co-operation of the Inspector General of Forests, from the Shan States in Burma. Though I searched with the utmost care, from village to village, I never came across a plot of land under the variety *tenacissima*. I can, therefore, confidently affirm that, so far as Bengal, Assam and Kangra are concerned, that form only exists here and there as a curiosity in the flower gardens of Europeans, and in all such cases the plants admittedly have been derived either from the Royal Botanic Gardens or from the Agri.-Horticultural Society's Gardens of Calcutta. It is nowhere grown by, or, so far as I could discover, known to the Native cultivators.

CHINESE
PLANT;
CHINA-
GRASS.No definite
evidence of
approach to
Sumatran
State.Wallibian
Specimens.Poa or Puya.
Conf. with
pages 10, 94,
66, 912.Recent
Collections.Absence of
the Variety.

BOEHMERIA
nivea.

The Chinese Plant.

INDIAN
PLANT.Burmah's
Collections.First Importa-
tion of Suma-
tran Plants
into India.Roxburgh did
not separate
the Sumatran
from Rung-
pur Plant.No Separation
from the
Chinese Plant.Plant Grown
in India might
have been
Changed.Roxburgh's
Observations
on Hemp and
Flax Sub-
stitutes.

30. If the fact that Burmann mentions *Urtica nivea* as seen with in India can be accepted as proof of his having actually seen specimens from this country, he was the first botanical author who had seen it. But it is somewhat curious that Roxburgh makes no mention of Burmann, and that he should have been unacquainted with the Indian plant until it was shown him by Dr. Buchanan-Hamilton.

In 1803 Roxburgh procured roots from Sumatra of the shaggy yielding nettle known as "*Caloor*." After having grown it for five years he obtained from Rungpur (and no doubt as I have just suggested through Dr. Buchanan-Hamilton) specimens of the Indian plant. With both these growing side by side in the Calcutta Gardens he refused to regard them as being *Urtica nivea*, *Linna.*, and apparently saw no reason to separate botanically the Sumatran from the Indian form. At all events he makes not the smallest allusion in the *Flora Indica*, to their differing in any respect, but, on the contrary, groups them together and endeavours to indicate one direction in which, to his mind, they differed from the Chinese plant. His words are "From the prevailing definition of that plant, '*Folius sub-orbiculatis utrinque acutis vel basi attenuatis*,' I must conclude to be a different species, for in all the plants in the Botanic Garden, originally from Sumatra from Prince of Wales' Island and from Rungpur, they are uniformly broad-cordate." Now this character of having broad-cordate leaves is one of the diagnostic peculiarities in the separation of the Malayas from the China plant. Roxburgh was so accurate an observer that from the facts mentioned I should, but for one further consideration, have been prepared to at once believe that, though the plant met with in India at the present day is undoubtedly the Chinese form, at the beginning of century, its place may have been held by the Malayas condition. Unfortunately Roxburgh's unpublished illustration (already mentioned) is distinctly more like *Boehmeria nivea* than *B. tenacissima*. It is by no means typical, however, the leaves being much too cordate.

One of Roxburgh's very last contributions to Indian economic botany, was a paper entitled "*Observations on Substitutes for Hemp and Flax*." The manuscript of that paper was written after he had left India, it was posted from St. Helena and printed in London in 1815, thus seventeen years prior to the actual publication of his *Flora Indica*. The manuscript of his great work had, however, been

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Roxburgh on Hemp Substitutes.

(G. Watt.)

SCHMERIA
nivea.

completed before his departure from India, so that the "*Observations*" may be regarded as amplifying and correcting the account given in the *Flora*. There are one or two noteworthy circumstances that may be here pointed out. In the *Flora* he only mentions, incidentally as it were, the Rungpar plant but would appear to have known comparatively little about it, since he does not give it its Bengali vernacular name. In the "*Observations*" he corrects this defect. In the *Flora* the citation of *Marsden's History of Sumatra* as also the spelling of the Malay name are incorrect, but correct in the "*Observations*." He still, however, calls the plant *Urtica tenacissima* R., and appears to have been ignorant of its existence in Assam. At all events he does not mention the name Riha or Rhea.

He corrects his botanical description in one or two directions, but these do not materially throw light on the question of the form of the species met with in India. One of these corrections may, however, be here mentioned. In the *Flora Indica* he describes the leaves as "long petioled, cordate hairy and a little hoary underneath, three-nerved." In the "*Observations*" he removes the qualification "a little," and thus describes the leaves as "hoary beneath." This modification might be viewed as an indication that he had seen a form of the plant with the leaves much more hoary than that which he had originally described. This modification in the description would be regarded as trivial, but for the circumstance that the distinction of the two forms might almost be said to turn on the appropriateness of the terms *nivea*, or *candicans* as applied to the tomentum of the under-surface. The word hoary seems to have been employed by Roxburgh with the latter signification and the description "long petioled, cordate hairy" taken in conjunction with "a little hoary," would describe the Malay plant but be very inappropriate to the Chinese.

21. In his "*Observations*" Roxburgh tells us that he regards Rumphius' table 79, figure 1, as "a very bad representation of our plant; but as the description agrees pretty well, we may conclude they are the same." In Rumphius' plate the leaves are not cordate, the venation is pinnate, and the stem much branched. It is not unlike a wild state of the Chinese plant, but, as Roxburgh remarks, is certainly a bad illustration of the Malayan. It is thus just possible that Roxburgh before his departure from India had recognised the more

CHINESE
PLANT:
CHINA-
GRASS.Roxburgh
Modifies his
Description
of the form
tenacissima.Rumphius'
Plate and
Description.

R. 172-213.

BOEHMERIA
nivea.

The Chinese Plant.

INDIAN
PLANT:
AREA.How
Roxburgh
was led into
a mistake.Jenkins
Discovered
it in Assam,
1833
Conf. with
para. 55.Burney
Discovered it
in Burma,
1836.
Conf. with
para. 102.

hoary condition of the Rungpur form without regarding that character of specific or even varietal value. But following the governing principle of his life—accuracy—it may be assumed that he had directed his artist to prepare a coloured plate of the Indian, not the Malaya plant. If this line of reasoning be accepted, we may, I think, with safety make the further inference that the Chinese and not the Malaya form has, from the very earliest times, as at the present day, been grown in India, and that the reputation to the contrary, which is current in the literature of this subject, proceeded from Roxburgh having been misled by Loureiro's erroneous description of the Cochín Chinese plant.

22. It is, however, to be regretted that in the Calcutta Herbarium there should not have been preserved the specimens collected by Roxburgh and Buchanan-Hamilton. There can be no doubt on this point, namely, that Dr. Buchanan-Hamilton was the earliest authentic discoverer of *B. nivea* in India. He gave it (1808) the vernacular name of *kanthura*, and said it was an *Urtica* and possibly *nivea* of Willdenow.*

Jenkins was the discoverer of the plant in Assam or rather Cachar. A letter from him dated 1833 (*Trans. Agri-Hort. Soc. Ind., Vol. II., 206*) gives in abstract all that we know up to the present date. He found it on the way down from Dhatum. It was being grown by the fishermen near their houses; it yielded two or three cuttings a year; the fibre was separated with steeping, the bark being scraped off with a knife. It was known as *Kwā*, and was a species of *Urtica*. Colonel Burney has the honour of being the discoverer of the plant in Burma or rather in the Shan States. In a letter to Kyd, dated 6th December 1836, he gives full particulars as to the method of propagation by root cuttings, the reasons for transplanting, and method of cutting the shoot. It was known to the Shans as *Pan* and to the Burmans as *Glas* (*Trans. Agri-Hort. Soc. Ind., III., Vol. 11*).

23. *No Structural Modifications in Plant.*—To these considerations it may be added that although the Calcutta Herbarium possesses a fairly extensive series of dried specimens of this *B. B.*

* Since the above has been in type I have had the pleasure to examine—through the kindness of Prof. Balfour of Edinburgh—Dr. Buchanan-Hamilton's n. 2013, collected on the 8th November 1808 at Cussipara. It is a typical *Boehmeria nivea*. There is no specimen in his herbarium, however, from Dinajpur. Conf. with paras. 39, 44 and 53.—G. Wall.

No Exhaustion of Soil.

(G. Wall.)

BOEHMERIA
nivea.

meria (some very possibly older than 1840) there is not a sheet of *B. tenacissima* that could be said to have been procured in India proper, all the Indian examples of that variety are admittedly derived from plants grown in the Botanical Gardens of Calcutta or of Scheranpur. While that is so, still the older of these herbarium specimens of *B. tenacissima* may have been cut from the descendants of the original Sumatran stock. If that assumption be admissible, it may be pointed out that both the dried samples in the herbarium and the live plants in the gardens are very nearly as true to the characters of the Malayan race as if they had been only just obtained from Java or Sumatra. Admitting that the two forms of the plant here indicated are but geographical races, cultivation in Calcutta for the greater part of a century would thus appear to have produced no material modifications in their structural characteristics. This fact may be exemplified by the following circumstance. Mr. James Montgomery obtained his stock of plants direct from China, 1843. These have been propagated ever since by root cuttings, practically on the same field (a period of 35 years) without showing either degeneration in fibre-yielding property, exhaustion of the soil, or any structural departures from the typical condition of the Chinese plant.

11. *Conclusion.*—The final result of these observations regarding the form of plant now met with in Indian cultivation and of the botanical specimens preserved in the Calcutta Herbarium, may be said to be that, following Roxburgh, most Indian writers on this fibre and the majority of systematic botanists in India, Europe and America, have regarded the Indian rhea as being *B. tenacissima*. I may mention in passing by way of illustration that so late as (16th Dec 1877) Mr. C. B. Clarke (at that time Officiating Superintendent, Royal Botanic Gardens), held that "the particular cultivated race known as Rhea in Bengal is the plant named by Roxburgh *Urtica tenacissima*, and is generally considered by modern botanists to be a mere variety arrived at by long cultivation from *Boehmeria nivea*" (see letter No. 243 to Secretary, Government of Bengal). Mr. Clarke would thus seem to have regarded the cultivated plant of China, India, and the Malay, as identical and to be *Urtica tenacissima*, Roxb., the wild plant being *Boehmeria nivea*. That explanation must now, however, be accepted as dispelled for, as already stated, the Indian plant is persistently Chinese. Throughout

CHINESE
PLANT:
CHINA-
GRASS.No
Exhaustion
of Soil.
Conf. with
para. 22,
161.Degree of
Cultivation.
Conf. with
para. 161.The Error
Regarding
the Indian
Plant.Confusion
between
Macoutia and
Boehmeria.
Conf. with
para. 19,
46, 113.

BOEHMERIA
nivea.

The Malayan Plant.

RAMI.

Limits of
Variation.
Conf. with
para. 12.

India wherever rhea cultivation is pursued, under sub-tropical and tropical conditions alike, the cultivated fibre-yielding plant is *B. nivea* never *B. tenacissima*. It varies within certain limits. The marginal serrations are at times minute and pointed, at others coarse and quite dentate in shape. The petiole is mostly short and thick, at others long and slender. The base is usually rounded or almost truncate, but in some instances is more or less drawn out but it only very exceptionally becomes cordate, that is to say, it has no sinus nor any attempt at rounded auricles. For the most part the leaves are thick and the woolly coating copious, but in neglected cultivation this greatly diminishes, becomes thinner and less woolly, but is always uniformly distributed (not mottled) and the under-side never becomes entirely green.

THE MALAYAN PLANT.

II. *Var. β tenacissima*, Miquel, *Flor. Nederl. Ind., Vol. I. 25*
(1859-60 ad.)

RAMI OR RAMIE.

BOTANICAL
LITERATURE.
Conf. with
para. 12
and
(Commercial)
26.

25. *Syn.*—*RAMIUM MAJUS*, Rumphius, *Amb., Vol. V., 214* (Esch. 1739 (1750 A.D.)); *URTICA CANDICANS*, Burmann (possibly also *U. astnans*, Burm.), *Flora Indica*, p. 197 (1768); *URTICA DIVIA*, Jacquin, *Hort. Bot. Vindob., II., p. 78, t. 166*; *URTICA TENACISSIMA*, Roxburgh, *Flora Indica*, Vol. III., p. 500 (1830-31); *U. CANDICANS*, Blume, *Bijdr. Flor. Nederl., p. 503* (1815); *BOEHMERIA TENACISSIMA*, Gaudich. *Bot. Freyc. Voy., p. 600* (1826); *BOEHMERIA CANDICANS*, Hassk., *Cat. Fl., p. 74* (1841); *BOEHMERIA TENACISSIMA*, Gaudich., *Blume Mus. Bot. Lugd. Bot., II., p. 311* (1849-56); *BOEHMERIA NIVEA*, Miquel in *Plant. Jungh., p. 33* (1850); *BOEHMERIA NIVEA*, Hook. et Arn. *var. β CANDICANS*, Weddell in *DC. Prod., XVI., Pt. 1., p. 206* (1869).

Conf. with
Burmes
Name,
para. 12.

26. *Vernacular Names.*—*Rami*, (Java) Malay; *Inan*, *Bona*, *Gambe*, *Celebes* (according to Rumphius); *Moumintram*, *Java* (according to Burmann); *Caloor*, *Sumatra* (according to Marsden and in Roxburgh's *Flora Indica*, given incorrectly as *Caloor*); *Rami* (according to Crawford) throughout the Archipelago; *Rami*, *rami gunn*, Malay; *Kiparoy*, *kapiertat*, *karamay lalakie*, *Sund*; *Kiam*, *Sum.*; *Inan*, *Amb.*; and *Gambe*, *Celeb.* (according to Blume); *Ramien*, *Mal.*; *Klori*, *Sakojan*, and *Goni* a variety met with in *Palembang* (according to Miquel).

B. 576-606.



BOEHMERIA TENACISSIMA

LEITCH, & E. O. CALVERT

Citation of Authors and Collections. (G. Watt.)

BOENNERIA:
var. *stenacissima*.

27. *Description of the Plant*.—This would appear to be a more robust form than the plant already described. *Leaves* of a thinner and smoother texture than in *B. nivea* proper and with the petioles considerably longer, more slender and more hairy. The blade is ovate, distinctly cordate even in the oldest leaves, that is to say, it has the base produced into rounded lobes so that the sinus gives origin to a pronounced elongation into the petiole. Veins of the lower portion often 5, owing to a pair of slender ones lining the margins of the sinus, in addition to the three very prominent main veins. Under-surface of young leaves hoary but with open or loose white wool which, as the leaf expands, partially separates from the texture and becomes collected within the meshes of the ultimate reticulations. This gathering together of the tomentum gives the leaf a mottled appearance, but in no samples seen by me were the leaves green below. The description given by Weddell of the leaves being concolorous would be highly inappropriate to all the specimens I have examined. The veins as also the most minute reticulations (on both surfaces) are freely coated with longish stout spreading hairs that often assume (more especially on the under-surface) a slightly redous tint. Owing to the tomentum being collected together, the veins and reticulations in this form show up very distinct and destroy the uniformity of the white felted coating that is so characteristic of the typical condition of the species. *Stipules* relatively small. *Inflorescence* usually longer than the petioles, at the same time more lax and more profusely branched than in the typical state.

Plate II was obligingly drawn and coloured for me under the orders of Sir George King, from a specimen grown in the Botanic Gardens, Calcutta. It thus represents one of the Indian cultivated states of the plant, but in its natural habitat the leaves are more deeply cordate and the inflorescence ever so much more profuse than in the plate. The drawing conveys the chief features of the form, however, more especially the copious reticulation, abundance of hairs, and mottled green and white somewhat bluish appearance of the under-surface of the leaf. So frequently does the statement occur, in connection with the cultivated states of this plant, that the leaves are green below and have at most white or pink veins, that I feel inclined to suspect there may be certain cultivated states with which I am unfamiliar (*Conf. with para. 32*). I would therefore repeat that I have

MALAYAN
PLANT.Description.
Conf. with
specimens,
para. 26.Leaves
Concolorous.
Conf. with
specimens, 27,
28, 30.

Plate II.

Never seen
with Under-
Surface
Green.
Conf. with
specimens, 27,
28, 30.

**BOEHMERIA
nivea.****The Malayan Plant.****Roxb.**

seen no plant cultivated in India nor any herbarium specimens of the Malay form, in which the leaves could for a moment be spoken of as green on the under-surfaces. Neither Roxburgh's description nor his coloured plate could be held to justify any such interpretation being put on his *Urtica tenacissima*.

**Weddell's
Classification.**

18. *Citation of Authors and Collections.*—It has been with considerable hesitation, however, that I have advanced the above synonymy of this form. In some instances I have been guided mainly by the habitat of the plant. There would seem to be little doubt that Burmann was the first author who isolated the Chinese from the Malayan condition of the species. But for the very imperfect description published by him, the variety here dealt with, by following the rule of priority, should have been distinguished by the name which he gave it, and indeed that course has been pursued by Weddell. On the other hand, there can be no doubt that Roxburgh was describing the Sumatran plant (and his description is an extremely good one) when he introduced the name *Urtica tenacissima*. Whether he was correct or incorrect in subsequently placing the Indian plant under that species, cannot be supposed to destroy the description of the Malayan plant. It accordingly seemed to me desirable to accept the position advanced by Miquel more especially since he was the first botanist to publish a correct definition of our variety as distinct from the typical state of the species.

**Miquel's
Views.****Jacquin's
Coloured
Illustration.**

But contrary to all other writers I have placed Jacquin's description and admirable coloured plate under this form, while I have transferred Roxburgh's unpublished drawing and Wight's copy of it from the variety to the typical condition. To the planter and manufacturer botanical nomenclature is of secondary consideration and, in fact, in this case, it is even to the botanist not material whether Weddell or Miquel should be regarded as having the prior claim of correctness in placing the Malayan plant as a variety under *Boehmeria nivea*. In consequence I have thought it desirable to preserve the best known varietal name of *tenacissima* rather than to give it what was very possibly its earliest name, *candicans*.

**Better known
Name.****Specimens
in Calcutta
Herbarium.**

It is somewhat curious that in the Calcutta Herbarium there should be no sheets of *B. nivea*, stated to have been obtained from the Gardens, while there are no less than four separate collections of the present variety. Of this nature I would mention, with B. 576-606.

herbarium, Wall. Cat. No. 4606 E.* In some respects this specimen looks as if it might have been a hybrid between the two forms. The chief objection to admitting the idea of hybridization, so far as India is concerned, lies in the well-known fact, first prominently made known by Roxburgh, in the case of the Malay plant (*Ochroma*, p. 72), that in India both forms rarely produce fertile seed. The Wallonian specimen mentioned, has the copiously branched and lax inflorescence as also the thin delicate hairy and minutely reticulate leaves of the variety, but the leaves could hardly be described as cordate, which they certainly are in the Malay plant. Then there is a sheet in the Calcutta Herbarium, contributed by Royle, doubtless obtained from the Saharanpur Botanical Gardens though this is not so stated. It has every one of the characters of the Malay plant.

Turning now to the botanical specimens in the Calcutta Herbarium that have been procured direct from the Malay, I would mention Griffith's (Kew distri.) n. 4564; Cuming's n. 2311 from Malacca; Jacq. Herb. n. 21 from Sumatra; Teljmann's n. 3966 from Sumatra (where it is called *Alor*); H. Kunstler's n. 356, collected in August 1880 at Salangor. This is described as "small tree on the sides of a hill on rocky ground. Leaves dark green, underneath silvery grey. Flowers yellowish, very small." This would therefore seem to be a wild state of the plant. It bears out the characters already indicated though the leaves are smaller, thicker and the stems thinner and more woody than in the cultivated fibre-yielding plant. The specimen here mentioned bears in fact an exactly parallel relation to the Malay cultivated stock that Fortune's wild plant bears to the Chinese.

Lastly, in the Calcutta Herbarium there are four very instructive sheets recently contributed by Mr. O. Curtis from the Penang Botanic Gardens. No. 1 is said to be "a tall woody form originally collected at Tanyong Bunga, Penang, probably introduced by China." No. 2 "obtained from Singapore Botanic Gardens: strong growing but not so strong as No. 1 and under-side of the leaves silvery grey." I am of opinion that both these plants are conditions of *Boehmeria nivea* var. *tenacissima* though No. 2 has much shorter inflorescence than

MALAYAN
PLANT.

Wallonian
Specimen.
Conf. with
para. 20.

Production
of Fertile
Seed.

Conf. with
para. 22.
See also
next page

Royle's
Specimen.

Griffith's and
Cuming's
Malacca
Specimens.

Teljmann's
Sumatran
Specimen.

Kunstler's
specimen
from
Salangor.

A Wild
Specimen.

Conf. with
para. 17,
20, 22.

Curtis'
Collections
from Penang.

* Since the above was written I have had the pleasure of examining Dr. Buchanan-Hamilton's collections preserved in the Edinburgh Herbarium as also a duplicate of Wall. Cat. 4606 E. which, I think there can be little doubt, is the present variety.—G. Wall.

BENNERIA
nivea.

The Malayan Plant.

RAMI.Modifications
in the
inflorescence.Saharanpur
Cultivated
Stock.Production
of fertile
Seed.Conf. with
purcs. 22,
23, 24, 25,
26, 27,
28.Intermediate
Form.Conf. with
purcs. 12,
13.

is usual. But I am disposed to suspect that, with a plant that rarely produces fertile seed and is mainly propagated by root cuttings, a wide latitude must be allowed for the peculiarities of the inflorescence.

In this connection I may mention a fact recently communicated to me by Mr. Gollan, Superintendent of the Botanic Gardens, Saharanpur, namely, that while the sub-tropical stock (*B. nivea*, proper) never produces fertile seeds in Saharanpur, the more tropical condition (var. *tenacissima*) does so regularly. This may perhaps be accounted for by the long cold season, followed by the sharp but dry season, tending to suspend the activity of shoot production and facilities for root propagation. The plant is thus compelled through adverse climatic conditions to reproduction by seed. On the same line of reasoning it may be mentioned that, as stated by Roemer, the Sumatran plant does not produce fertile seed in the warm damp climate of Calcutta, while in Rungpur and to some extent in Assam also, the Chinese form frequently yields fertile seed.

But to conclude this reference to the Curtis' Penang specimen it may be mentioned that Nos. 3 and 4 are typical examples of *B. nivea*. Regarding No. 3 Mr. Curtis notes on the label "received from abandoned Chinese garden. Height about four feet. Leaf-stalk pink (a very distinguishing feature). This is the variety referred to by Mr. Ridley in Bulletin No. 7 as having hollow stems."

29. *Indian Hybrids*.—I would here add by way of concluding these remarks regarding *tenacissima* that I have collected both in Bengal and Assam a very extensive series of specimens that might very possibly be supposed to be intermediate in certain respects to *B. nivea* proper and the variety *tenacissima*. Whether these were originally derived from the former or the latter I am unable to decide, but am inclined to think they might more properly be looked upon as hybrids. In all these the petioles are greatly elongated, and while the base of the leaf is never cordate it is drawn out into the petiole in the manner characteristic of *tenacissima*. Further the tomentum is much thinner or less copious, than in the typical plant and in old leaves becomes gathered together in tufts especially near the veins, in a manner very similar to the condition present in *tenacissima*. Moreover, while the under-side of the leaf is certainly never green nor devoid of a woolly coating, the veins are often broad and succulent looking, also coloured, while the leaf-

B. 576-606.

Habitat.	(G. Watt.)	BEHMERIA: var. <i>B. tenacissima</i> .
<p>stalks are unusually hairy, that is to say, they are clothed in long spreading hairs.</p> <p>For convenience of future reference I may quote here the numbers given by me to the more striking manifestation of this condition. Nos. 12139, collected at Jalpaiguri; No. 12201, collected in Rungpur; Nos. 12207 and 12210, collected in Bogra; No. 12240, collected at Subagar; and Nos. 12325, 12329, 12333, 12338, 12340, 12350 and 12367, collected in Kamrup in Assam. The Kamrup specimens were procured for me by a Native plant collector whom I sent on tour through that district with instructions to visit every known rheaproducing village. The abundance of this form in Kamrup (North bank only) is somewhat significant. And there is a further circumstance that I may here add in connection with Kamrup; the same plant collector brought me two specimens which he at first said he had found in the jungles, but which, he subsequently admitted, were discovered near villages and on deserted fields. These match to a society Fortune's wild rhea from China. The stems are thin and woody and the bark chestnut coloured. The leaves are not more than an inch and half in length, but in shape and condition of tomentum they are <i>B. nivea</i> proper and possess none of the peculiarities that I have mentioned above, of the presumed hybrid state of what is so characteristic of much of the Kamrup cultivated stock.</p> <p>30. <i>Habitat</i>.—After what has already been said and the citation given of authors and specimens, it need hardly be remarked that this form can almost with safety be regarded as indigenous to the Malay Archipelago. It has been the <i>Rami</i> of all writers regarding that region, during the past 200 years at least. Rumphius does not, however, mention it as met with, except under cultivation and, indeed, none of the older authors speak of having seen it in a wild state. The very frequent application of certain vernacular names (not known outside the Malay, except as derived from that Archipelago); the antiquity and derivation of these names; and the constancy of the type of plant from the region in question, leaves little room for doubt, however, as to its being a native of that area. Moreover, some of the modern writers and indeed not a few botanists affirm that it does exist, even to the present day, as a wild plant in the Malay Archipelago.</p>		<p>MALAYAN PLANT.</p> <p>Assam Probable Hybrids.</p> <p>Degenerated Conditions. (Conf. with paras. 17, 22, also 28, 29.)</p> <p>Indigenous to the Malay. (Conf. with paras. 17, 22, 23, also 28, 29.)</p>

BOEHMERIA
nivea.**The Malayan Plant.**

RAMI.
Erroneous
Notions
Regarding
Origin of
this Plant.

Possible
Previous
Existence of
Hybrids.

Plant with
Leaves Green
below.
Conf. with
p. 17,
18, 27.

Suitability
to Tropical
Regions.

Rhea and
China-grass
Synonymous.

It would, perhaps, serve no very useful purpose to furnish an extensive series of passages indicative of the erroneous notions that have been currently held regarding this plant. The following which appeared in 1897 in "*The Indian Daily News*" may be accepted as fully representative: "The *Boehmeria tenacissima* is the name of the variety found in Central America, which is there known under the name of Ramie and does not occur in India." The above appeared in a review on a *Notes on the Cultivation of Rhea in Assam* by Mr. Monahan, Director of Land Records and Agriculture in that Province. The writer of the review continues, "Mr. Monahan does not say this; but we do." As a garden curiosity the variety *tenacissima* is no doubt experimentally grown in America as well as in India. It was found by me in that condition in Assam on more than one occasion, and may be seen at the Botanic Gardens, and I believe also at the Agri-Horticultural Society's Gardens, Calcutta. But if the idea of hybrids between the two forms be admitted, India possesses an extensive series, and these very nearly of necessity involve the previous existence of *B. nivea* var. *tenacissima*.

Dr. Morris (Assistant Director, Royal Gardens, Kew), in a lecture delivered before the Society of Arts (October 14th, 1895) makes the following observation regarding this plant: "The terms *ramie* or *rhea*, should only be applied to the variety *tenacissima*. This differs from the type by its more robust habit and larger leaves, which are green on both sides. This character easily distinguishes it from China-grass, which has leaves white-felted beneath. The distinction here suggested is an important one. *Ramie* or *rhea* is native of Assam and the Malay Islands. It thrives only in tropical countries, and it is useless to cultivate it elsewhere."

In the Dictionary of Economic Products (*Vol. VI., Pt. I., p. 11*) I advanced the opinion that the Malay plant, being a native of a damp tropical region, might be better suited to many parts of India than the Chinese plant. At that time, having not personally explored the areas of *rhea* cultivation, I fell into the common error of regarding the *rhea* plant of Assam as the same as the *ramie* of the Malay. From what I now know I have no hesitation in affirming that *rhea* and China-grass are synonymous names for *Boehmeria nivea*, and that the name *ramie* should be exclusively assigned to the variety *tenacissima*. But I have no evidence of any kind that

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Japan and Formosan Plant. (G. Hatt.)

BOEHMERIA:
tenacissima.

would go to support the notion that either the one or the other is a native of Assam.

31. *Comparative Value*.—Whether as a fibre-yielding plant it is superior or inferior to the China-grass, remains one of the most important problems for the future to solve. Mr. Ridley, Director of the Botanic Gardens, Singapore, is entitled to speak authoritatively on this point. In a recent paper of his that appeared in the "*Straits Times*," he says:—

"There are two distinct varieties of Ramie or China-grass, *Boehmeria nivea*, in which the backs of the leaves are white, and Rhea, *B. nivea* variety *tenacissima*, in which the backs of the leaves are green. The English and Native names are often jumbled up, but it will be understood that, in these notes Rami is the white and Rhea the green-leaved form. Now, Rhea fibre is always considered much inferior to Ramie, but it is commonly said that Rhea, which is a native of tropical regions, would probably be better for East Indian cultivation than Ramie which is said to be a native of China, and which can absolutely be grown out of doors in England with care. Curiously, however, Ramie grows remarkably well in the Straits, while Rhea, even from Sumatra, does not appear so strong or healthy."

Why Mr. Ridley should have given the Malay name to the Chinese plant and translated the Assam name to the Malay plant is a little difficult to understand. This much is certain (as already remarked) that it would be more in accord with the botanical histories of the two plants to speak of China-grass and Rhea as synonymous terms, denoting *B. nivea*, and to restrict the Malayan name *Rami* to the plant of the Malay Archipelago. But I concur with Mr. Ridley most willingly on one point, namely, the remarkable adaptability of these plants to climatic conditions. Contrary to all my preconceived notions I am free to admit I met with little, in the behaviour of *B. nivea*, during my recent investigations, that would justify the conclusion that it cannot be successfully cultivated in certain portions of tropical India. Indeed it seems to flourish alike in moist sub-tropical and dry warm temperate regions. But we have had no sufficient experience in India with the Malayan plant to authorize any opinion being framed as to its behaviour and value as a fibre crop. From the presumption that it is a native of the Malay it might be assumed to be a tropical condition of the species, but both forms manifest a remarkable power of adaptability to environment.

MALAYAN
PLANT.Comparative
Value as
Fibre-yielding
Plants.
Conf. with
para. 22.The Green
and the
White-leaved
Forms.Conf. with
paras. 17,
18, 27, 30.Adaptability
to Climatic
Conditions.

**BCHMERIA
NIVEA.**

Cultivation of Rhea in India.

NAME.

Production of
Fertile Seed.
Conf. with
para. 17,
26, 28.

**Green-leaved
form.**

Conf. with
para. 17,
26, 27, 30,
31.

It is probable that even in their wild states both plants are largely perpetuated by root development and naturally produced cuttings. So much would this appear to be so that it has already been suggested that the tendency to form seed may be looked upon as an unfavorable prognostication, *vis.*, unsuitability as a fibre-yielding plant to the climatic conditions of the region of cultivation.

32. *Japan and Formosan Plant.*—Before leaving the subject of the probable habitat of this form I take this opportunity to say that, in the Calcutta Herbarium there is a specimen of a form said to have been collected at Yokohama in 1862. This was issued from the *Herb. Hort. Bot. Petropolitani* by Maximowicz. It is in my opinion *B. nivea*, *Gaud. β. tenacissima*, but is possibly entitled to recognition as a sub-variety. It differs from the Malay stock by the leaves being much smaller, and, while copiously covered with hairs on the veins and reticulations, is sparsely coated with silvery tomentum. (Conf. with para. 27.) Could this be the origin of the cultivated plant spoken of by many authors in which the leaves are green below? The base of the leaf is not at all cordate. The plant is in fact practically intermediate between the Chinese and Malayan form. DeCandolle says that according to Franchet & Savatier (*Enum. Plant. Jap., I., 439*)—what is possibly the plant just mentioned—"exists in Japan in clearings and hedges." So again Henry's specimen from Formosa, which is stated to have been found "wild," is very much more like the Japanese than either the Chinese or the Malayan plants.

It would thus seem probable that the cultivated fibre-yielding plants may have been derived from three independent stocks, *viz.*, the Chinese, the Japanese (including the Formosan), and the Malayan.

CULTIVATION OF RHEA IN INDIA.

33. Having in the foregoing paragraphs attempted to bring together the more important considerations connected with this plant from the botanical standpoint, it may now be desirable to set forth some of the chief particulars that have been recently brought to light regarding it as an Indian fibre crop. It may be taken for granted that my botanical investigations have revealed the fact that in India the Chinese, and not the Malayan, plant is at present being cultivated. In the *Dictionary of Economic Products* I have already urged that being a more tropical form, the Malayan plant would very possibly

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The Chinese
not Malayan
Plant.

Rhea (Rhea) or China-Grass.

Review of Agricultural Information.

(G. Watt.)

BOEHMERIA
nivea.

be found better suited to India than the Chinese. I was not, however, then aware that the Malayan plant was not actually being grown as a fibre crop in India, and my contention in that work was mainly that European planters who may contemplate an extended production should experiment with both forms. It has often been stated that in Europe the clean fibre (China-grass) from China fetched a higher price than the corresponding fibre from India. This was by many supposed to be due to the fact that in India the plant cultivated (as Roxburgh and many subsequent writers had affirmed) was *Boehmeria tenacissima* and not *B. nivea*. We now know, that if the Chinese fibre is actually superior to that obtained from India, that fact must be accounted for by its being supposed that in India the plant does not afford a fibre of the same quality as in China, or that the Indian method of separating and cleaning the fibre is deficient to that pursued in China. In consequence the question of the comparative values of the two fibres is shifted from India to the Malay Archipelago. The companies that have been announced as established or very shortly to be established in the Malay would do well to give this subject their careful consideration, and the planters in India who contemplate rhea cultivation have also to solve an important question, *viz.*, which form of the plant gives the best return in adaptation to local climatic and other conditions?

34. I shall now attempt to furnish a review of the available information on the subject of Rhea cultivation in India. In doing so I shall first of all give a fairly complete statement (approximately in sequence of date of publication) under a paragraph of reference, of all the more important books, reports and newspaper articles that have appeared and been consulted by me. This may serve the purpose of enabling the reader who may so desire to verify the statements made and to discover whether he is in possession of information not consulted by me. In the second place, I shall take up each province separately, and furnish such particulars as seem of more direct local interest.

I had hopes of being able to furnish a concluding chapter to this report that might have afforded the means of definite opinions being formed as to the prospects financially of a venture in rhea cultivation. But I have failed absolutely in this expectation. I have been unable to obtain trustworthy data on such all important points as cost of

INDIAN
CULTIVATION.

Comparative
Value of
both Fibres.
Conf. with
para. 31.

Chinese
Fibre Super-
ior to the
Indian.

Which Form
will give best
Return in
India.

Publications
Consulted.

Financial
Prospects.
Conf. with
para. 9, 48,
65, 71, 81,
83, 84, 103,
106, 109.

BEHMERIA sives.

Cultivation of Rhea in India.

BEHMERIA CULTIVATION.

Character
of Indian
Cultivation.
Conf. with
para. 59.

Price does
not tempt
Extended
Cultivation.

COMMERCIAL LITERATURE.

Conf. with
para. 19,
23 (for
Botanical).

production, yield, prices likely to be realized, etc., etc., and therefore to advance personal opinions on the subject of the probable margin of profit, in the absence of definite particulars, seemed to me undesirable.

35. Rhea cultivation is nowhere pursued in India in more than plots of a few yards in length and breadth, adjoining the homesteads. It receives in such limited cultivation a much larger amount of manure and is more carefully supervised than would be possible with a field crop. The yield varies according to the extent of manure and supervision and so widely that the returns given by one cultivator bear no possible relation to those of another. The fibre is hardly a commercial product. It is grown as a rule by the householder consumer who can with difficulty be induced to put down more than he requires. The price offered has so far failed to tempt an extended cultivation and the labour of separating and of cleaning the fibre have made it very unpopular.

36. *References.*—*Voyage of John Huyghen van Linschoten to the East Indies, 1596—passage on "Herbe Bengalen"* (which appears to probably refer to this fibre (Ed. by Burnell, 1881 and Yule), Vol. I., 96; Marsden, *History of Sumatra*, 1793; Roxburgh, *Observations on Substitutes for Hemp and Flax*, 69-75, also letter to James Money, Esq., Secretary, British Trade, Calcutta, Mar. 22nd, 1809; Crawford, *First Ind. Archip.* (1810), I., 442; Buchanan-Hamilton, *Statistical Account, Dinajpur* (1813), 194, 198, 201; Jenkins, *Trans. Agri.-Horti. Soc. Ind.* (1813), Vol. II., 206; Burney, *I. Ind.* (1835), pp. 10-11, also pp. 137-8; Robinson, *Dissem. Account of Assam* (1841), 67, 87; Fortune, *Three Years' Wanderings in the Northern Provinces of China*, 13; Fibrous Materials of Assam and Chittagong—*Jour. Agri.-Horti. Soc. Ind.* (1843), VI., 181-85; Macgowan—*Jour. Agri.-Horti. Soc. Ind.* (1848), Vol. VI., pp. 209-19; Falcater, *Specimens Collected by Macgowan, l.c.* VII., 18-19; Baker (Sir W. J.), *Journal of Botany* (1849), Vol. I., 85, 159, 200 (1851), Vol. III., 312-315, Pl. VIII.; Paxton, *Magazine of Botany* (1849), Vol. XVI., 349; Royle, *Rhea Fibre of Assam and the True Chinese-grass of China*, *Journ. Soc. Ind.* 10th Dec. (1851), Vol. II., pp. 60-61; Rhea Fibre of Assam *Jour. Agri.-Horti. Soc. Ind.* (1854), Proc. Vol. VII., 11-19; also *Fibrous Plants of India*, pp. 345-364; Fergusson, "Calcutta Review," XXII (1854), 347; Samuel Gregson, *Notes on Rhea in "Calcutta Review,"* XXIII., (1854), 314, 315; Rhea in Assam, *Journ. Agri.-Horti. Soc. Ind.* (1854), Vol. VII., 155-60; Mason's *Burma and Its People*, 319 & 775, 777.

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Enumeration of Chief Publications.

(G. Watt)

BOEHMERIA
nivea.INDIAN
CULTIVA-
TION:
Literature
of Rhea.

Birdwood, *Bombay Products* (1862), p. 318; Squier, *Tropical Fibres* (1863), 55-56; King (Sir George), *Journ. Agri-Horti. Soc. Ind.*, Vol. I. (n. s. 1869), 400-11; Note by Secretary, *Agri-Horti. Soc. Ind.*, Vol. I. (n. s. 1869), *Proc.* 19th May, pp. xxviii-xxx; *Letters, Papers or Memorandum on Rhea Cultivation in India* by Rie. Lynden, M. Montgomery, Pashe, Bonavia, Brandis, Sandys, etc., in *Proceedings Home Dept., Govt. of India*, Oct. 16th, 1862; 11th Jan. 1870; 5th Feb. 1870; 31st Dec. 1870; 10th Jan. 1871; and 11th Feb. 1871; Report, Bengal Chamber of Commerce, 10th Apr. 1871, pp. 69-91 (Reviews the Action of Govt. of India in Offering Rewards for Machinery); De Malartic, *Journ. d'Agric. Pratique*, Vol. II., No. 31; Siepmann's *Journ. Botany*, Vol. X (1872), 186; Dalton, *Ethnology of Bengal*, p. 20; Forbes Watson, *Indian Industrial Survey, List of Products*, 130; De la Roque, *Journ. d'Agric. Pratique*, No. 29; Jameson, *Notes on Cultivation of Cinchona and Rhea in India—Bot. Soc. Edinb.*; Drury, *Useful Plants of India*; Hem Chunder Kerr, *Report on Cultiv. of and Trade in Jute in Bengal*, pp. 4-6; Brandis, *Forest Flora*, 402; Baillon, *Nat. Hist. Plants*, Vol. III., 504; Roxburgh, *Flora Indica* (Ed. C. B. Clarke), 656; The Ramie, *Throphile Marman*; Forbes Watson, *Report on Preparation and Use of Rhea*; Guide Saidapet Expt. Farm, Madras; *Gazetteer, Saharanpur*, N.W. P., II., 173; Report, *Agri-Dept.*, N.W. P., 1877-78, p. 16; Report, *Royal Bot. Gardens, Calcutta*, 1877-78, p. 3, and 1878-79, p. 1; Christy, "New Commercial Plants," No. 6, p. 38; Rice, *Mysore and Coorg Gaz.*, III., 46-47; *Proceedings, Govt. of India, Rev. & Agri. Dept.*, Nos. 13-22 of 1879; "Indian Forester," IV., (1879), pp. 166-67; Report of Committee Appointed to Test Rhea Fibre-extracting Machines, 1879; Vilmorin, *Bon Jardinier*, I., 700; Vétillard, *Etudes sur les Fibres Vegetables Textiles*, p. 99, pl. 2; Preparation of Rhea in Bhagulpur, *Journ. Agri-Hort. Soc. Ind.* (1880), Vol. VI., 170-7; Note on Growth and Preparation of Rhea by Messrs. Burrows, Thomson & Mylne (1881); Gamble, *Man. Timbers*, 324; DeCandolle, *Origin Cultivated Plants* (French Ed. 1852), English Edition, 1884, pp. 146-48; Atkinson, *Himalayan Districts*, X., 879-83; Forbes Watson, *Lecture delivered before Society of Arts*, 12th Dec. 1883; Carding & Bleaching of Ramie, "Scientific American," June 16th, 1883; "The Paper-makers Monthly Journal," 15th Mar. 1883; "Tropical Agriculturist," Jan. 1st and June 1st, 1883; "Indian Forester," IX., 274; X., 82-89; XI., 73; XII., 415; XIV., 167; Mason's *Burma and Its People* (Ed. Theobald), p. 265; Kangra *Gazetteer*, 189-60; *Spon's Encycl.* I., 921-32; *Les Artes Textiles, Culture*

B. 172-213.

BOHMERIA
nivea.

Cultivation of Rhea in India.

INDIAN
CULTIVA-
TION;
Literature
of Rhea.

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Rhea (Rhea) or China-Grass.

Cultivation in Bengal.—History.

(G. Watt.)

BOEHMERIA nivena.

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BENGAL
CULTIVA-
TION:
Literature
of Rhea.

CULTIVATION IN BENGAL.

37. *History*.—I have already stated that the first authentic record of the cultivation of this plant in Bengal occurs in Dr. Buchanan-Hamilton's *Statistical Account of Dinajpur*. That work was originally written some time between 1807 and 1811. The Government

BENGAL.
First Men-
tioned by Dr.
Buchanan-
Hamilton.

RHEA CULTIVATION
IN
BENGAL.

Discovery by Dr. Buchanan-Hamilton.

RHEA CULTIVATION

had deputed that distinguished scientific author to make a survey of Bengal. During the years mentioned he completed his explorations and wrote reports on—

"Dinajpur, Rungpur, Puraniya, Bhagulpur, Behar and the City of Patna, Shahabad and Gorakhpur. Upon each of the districts he submitted a voluminous report, accompanied with statistical tables, maps and drawings, and where an opportunity was afforded him of collecting it, with collateral information illustrative of the people, or of the geography and natural history of the neighbouring countries." "The original records, occupying twenty-five folio volumes in manuscript, were transmitted by the Indian Government to the Honourable Court of Directors a copy of the whole having been previously made, and deposited in the Office of the Chief Secretary in Calcutta." "It is matter of surprise and regret, that these valuable documents were not given to the public when stamped with the interest of originality and immediate applicability to the actual circumstance of the districts."

Buchanan-Hamilton's
Investigations in
Bengal.

The above passages have been abstracted from Captain J. D. Herbert's preface to the volume on Dinajpur (published, Baptist Mission Press, Calcutta, 1833) which he undertook to issue in connection with the journal he edited—*Gleanings in Science*. But as no other volumes subsequently appeared, it may be assumed that the far the major portion of Buchanan-Hamilton's great work has been entirely lost.

This digression from the direct history of rhea cultivation in Bengal has been thought desirable in order to convey to the reader who may not have the privilege of consulting the *Statistical Account of Dinajpur*, some conception of its value and the degree of importance that must of necessity be attached to every word in the passages devoted to the description of this fibre. Had it been possible to consult Buchanan-Hamilton's account of Rungpur and Bhagulpur there seems little doubt much additional light might have been thrown upon the early history of this Bengal-crop.

Buchanan-Hamilton's
Illustrations of
Bengal
Plants.

38. In passing I may mention that through the great liberality and kindness of Sir George Birdwood, K.C.S.I., I was presented some few years ago with a manuscript volume of coloured illustrations of Bengal plants. The only date upon the volume is that shown in an index, namely, June 1788. But the scientific names of the plants are, it is believed, in the handwriting of Dr. Buchanan-Hamilton and the vernacular names are those given to the same plants at the

Confused with Hemp.

(G. Watt)

BCHMERIA
nivea.

present day in Bengal only that they are written in Hindi character—a somewhat curious circumstance. Whether the drawings are Dr. Hamilton's own or those of some still more ancient botanist which he had simply named, cannot now be determined; but it may be added that, while many of the plants described in the *Statistical Account of Dinajpur* appear in the volume, there is no illustration of the plant which he calls *Urtica nivea*, Willd. The date on the index (19 years prior to 1807) would of course render that an improbability in any case, but if the manuscript and drawings prepared during his survey of North and Central Bengal could be now procured, much light would very possibly be thrown on this somewhat obscure subject.

30 *Buchanan-Hamilton's Description*.—On page 194 of "*Dinajpur*" the following passage occurs:—

Kankhura.—This is a species of *Urtica*, and perhaps the *nivea* of Willdenow. I have seen it nowhere else except in this district. It is a woody plant, and its bark is frequently used by fishermen to make a kind of hemp, of which they form the ropes for their nets, and all the ropes used for tracking boats are made of this material. It is propagated by slips from the roots, which are planted out in the beginning of the rainy season. There are no fields of this plant, but many gardens have a few beds. The leaves are used as a green, but are very indifferent, and fresh shoots are cut and steeped in water to procure the fibres of the bark. It is a perennial plant."

Then again under his chapter on Agriculture—*Section 3.—Plants grown for producing thread or cordage*, Dr. Buchanan-Hamilton gives the area in Dinajpur devoted to the four chief fibres as follows:—

"1. <i>Put. Corchorus capsularis</i>	Bighas 40,000
"2. Cotton	" 25,000
"3. <i>Son. Crotalaria juncea</i>	" 14,000
"4. <i>Kankhura, Urtica nivea</i>	" 1,000
TOTAL	Bighas 80,000

There are two points in the above passages that may be specially noticed: Dr. Buchanan-Hamilton says he had seen it nowhere else except in Dinajpur. The shoots were steeped in water to procure the fibre. Both these statements, it will be seen below, are at variance with modern Indian experience.

ORIGINAL
DISCOVERY.Buchanan-
Hamilton's
specimens.Conf. with
parcs. 77
and 86.

Root Cuttings.

Conf. with
parcs. 89,
90, 93, 96,
97, 102, 104,
105.Steeping in
Water.Conf. with
parcs. 54,
79, 89, 100.Dinajpur
Area under
Crop in 1807.Conf. with
parc. 48.Found in
Dinajpur
only.

BOEHMERIA
nivea.

District in which Rhea is Cultivated.

GENERAL
CULTIVATION
Origin of
Word Gunny.Confusion
Made by
Early
Authors.Crotalaria
Sann Hemp.
Conf. with
para. 8, 29,
24.the Old Error
Corrected.

40. *Confused with Hemp.*—I have already quoted (para 5) the somewhat significant remark which Buchanan-Hamilton makes regarding jute or as he calls it *pat*, but in passing it may be here said that he derives the word gunny (a name given to this day to jute sacking) from an old name of the jute plant which the author of the *Herb. Amboinensis* employs (Vol. I., tab. 78 f. 1), namely, *ganja* or, as Rumphius himself spells it, *ganu*.^{*} I have mentioned this circumstance since in the writings of the oldest authors, the greatest possible confusion prevails regarding *Cannabis sativa* (the true hemp)—the plant that yields the narcotic now known as *ganja*—; *pat* or, as we call it commercially at the present day, jute (*Corchorus olitorius* and *C. capsularis*); *sann* hemp (*Crotalaria juncea*); and *rhea* or *hankara* (*Boehmeria nivea*). It would be a digression too serious from my present purpose to exhibit the probable histories and derivations of the words *Cannabis* and *Sann*, but I may add we have in all probability received the word *Hemp* as an English generic term (equivalent nearly to the Chinese *Ma*) for these and one or two other fibres, as the final outcome of that confusion. Practically all the early writers on *rhea* speak of it as a kind of "hemp." Dr. Macgowan went further and named the plant that afforded the China-grass as *Cannabis sinensis*.

Dr. Munter read a paper before the Society of Naturforschende Freunde, Berlin, on the 21st November 1848, on the subject of China-grass cloth. This was reported in the *Botanische Zeitung* for the 12th January 1849, and was reviewed by Sir W. J. Hooker, in the *Journal of Botany*, Vol. I. (1849), page 159. The Yellow Grass-cloth, Dr. Munter said, was yielded by "a sort of *Cannabis*," while the white Grass-cloth was produced, he affirmed, from *Corchorus capsularis*. Sir William Hooker fully exposed the mistake that Dr. Munter had made. But by way of concluding these remarks it may be added that Dr. Munter's paper was perhaps the last statement by a scientific writer in which the old error of confusing hemp, jute and *rhea* occurs.

^{*} I would here mention what appears another example: Dr. Campbell tells us that a cloth made in Nepal from the fibre of *Girardinia heterophylla* used to be designated *bhanga*—a word probably derived from *bhang*, another of the hemp narcotics.

Explorations in Dinajpur.

(G. Watt.)

SCHEMERIA
nivea.

41. *Districts in which Rhea is not cultivated.*—But to return to the subject of the cultivation of *kankura* in Dinajpur, Dr. Buchanan-Hamilton's statement has been repeated by all subsequent writers, and I regret to say so far distorted by many, as to be spoken of ultimately as an abundant wild plant, extensively cultivated in the district in question.

On the Government of India directing that I should conduct a personal tour of exploration through the chief districts of Bengal and Assam, in which *kankura* or *rhea* cultivation was pursued, I addressed a circular letter to the Collectors of the districts in which I thought it very possible the crop might be found. My object was, if possible, to obtain a list of the villages that I might visit in order to study its cultivation. I was much surprised when I obtained the reply from Dinajpur that *kankura* was practically not grown anywhere in that district. In the under-mentioned districts of Bengal *rhea* or *kankura* is not cultivated by the people: Burdwan, Chittagong, Dacca, Howrah, Hughli, Jessore, Maldah, Midnapur, Murshidabad, Mymensingh, Nadai, Pubna, Purnea, Rajshahi, and Tippera.

Districts in which Rhea is Cultivated.

42. *Dinajpur.*—I visited Dinajpur and made extensive explorations by marching on foot day after day, through the more important agricultural tracts of the district. I nowhere came across either a cultivator who could be said to have had a personal knowledge of the *kankura* plant, nor could I discover a plot of land under the crop, until I had reached the most northern and eastern portions of the district at Birganj, Joyganj and Nawabganj—on the borders of Rangpur and Bogra districts. On one occasion I was informed by the Collector that he had obtained word of what appeared to be the plant in the Southern part of the district and of its existing in a wild state. Before leaving Dinajpur I accordingly took an opportunity of making a special march of 39 miles from Akkelpur to Sonai and Patnaila in order to see this reputed wild *kankura*. But on arrival I was grievously disappointed on being taken to a small deserted field and ruined village site, lying between extensive jute tracts, in order to be shown a few plants of *Hibiscus Abelmoschus*, which the owner called *kankura*. These were certainly not wild though they were not exactly cultivated, but the fibre, I was assured, was regularly made from the stems and used for fishing lines.

DINAJPUR.

Distortions of
Buchanan-
Hamilton's
Statements.Not
Cultivated
in Southern
Districts.DINAJPUR.
Conf. with
para. 39.Confined to
the most
Northern
Parts of
Dinajpur.Report
of Wild
Kankura.
Conf. with
paras. 6-7,
41, 44, 55,
60.

R. 172-213.

**BOEHMERIA
nivea.****Districts in which Rhea is Cultivated.****GENERAL
CULTIVATION**March
through
Jungle
Tracts.

Is not Wild.

Conf. with
paras. 6-7,
17, 24, 30,
33, 41, 46,
58, 60, 74,
77, 88, 103,
122, 124,
127.Experiment
of Rhea
Cultivation.Was Aban-
doned
Because it
did not Pay.Plant has
not Survived
in the
Jungles.Conf. with
paras. 18,
22, 29, 60,
212.

On another occasion I marched from the saddle station at Dinajpur to Joyganj and Gopalpur through a rich fertile country, every village for considerable distances off the main road being carefully examined for, and the cultivators questioned regarding their knowledge of *kankara*. A portion of this long and somewhat tedious march of five days' duration was through the wild scrubby jungles that now represent the once tiger-infested forest of which Dr. Buchanan-Hamilton has so much to say. No better opportunity could have been afforded me of testing the question whether the plant existed in a wild state in Dinajpur. The tall trees that once flourished have disappeared, but bushes some six to fifteen or twenty feet in height cover the tract and would afford the shade that rhea is universally said to seek, while the soil is a sandy loam on which one would have expected to find the plant. These uncultivated expanses were explored with the utmost care, but no trace of *Boehmeria nivea* could be found.

43. At Joyganj I was informed the late Rajah Syama Shankar Roy, Bahadur, was induced some fourteen years ago to experiment with the cultivation of rhea. He laid out several plots of high land in the aggregate coming to something like 600 acres, and placed Mr. Gow Smith in charge of the plantation. Great difficulty was experienced in procuring stock. Plants could not be obtained in the Dinajpur district and the cultivators in Kaunia in Rungpur demanded such high prices that roots had ultimately to be procured from the Calcutta and Saharanpur Botanic Gardens. No particulars had been preserved in the Rajah's Office of the results obtained, and the present owners of the estate could, therefore, afford me no definite information except that the plants grew remarkably well and gave three and sometimes four cuttings of stems a year. The experiment had to be abandoned as the price offered for the ribbons of bark was not equal to actual cost of production, and also because no market had been found that could economically separate and clean the fibre. I personally inspected one of the plots of land used in this experiment, viz., at Joyganj itself. It was on the bank of the river, but above inundation level. It has not since been cultivated but, though I looked everywhere, I could neither find on the neglected plantation, nor in the neighbouring jungles, any trace of *Boehmeria nivea*. On mentioning this fact to my friend Babu Pran Senkar

B. 576:606:

Migration to Rungpur.

(G. Watt.)

BOEHMERIA
nivea.

My Chandhuri, part owner of the estates and brother of the late Rajah, he said he could show me one plant that had survived in a neglected corner of his flower garden. This I examined and found typical *Boehmeria nivea*, but I venture to think that the entire disappearance of many thousand roots in fourteen years, fully disposes of the report of the plant being a native of this part of Bengal.

41. *Migration of the Plant.*—Here then we have another of the many perplexities that beset the study of rhea cultivation in India. The plant is certainly not wild and practically is not even cultivated in Dinajpur. How are we then to account for the abandonment of the 1,000 *bigas* which Dr. Buchanan-Hamilton established as the area under the crop in 1807? The cultivation of the crop must either have been entirely discontinued, or the area assigned to the district during the beginning of the century must have embraced a considerable portion of what is at present designated Rungpur. The latter explanation may possibly be the correct one, but I am assured by the Collectors of both districts that there are no records to show any such re-arrangements. On the other hand, there seems no doubt that a change has come over the district of Dinajpur since the date of Buchanan-Hamilton's explorations, and of so revolutionary a nature that it would be no great stretch of imagination to suppose the crop to have been swept away by the modern wave of popularity for jute cultivation. Of one point we may feel certain as indicative of change, viz., that whereas Buchanan-Hamilton found the *kankura* nowhere else except in Dinajpur, its cultivation has extended North and East into Rungpur, Jalpaiguri and Bogra.

But, when it is recollected that there has been considerable confusion in the botanical identification of the plant, and that the supposition has had to be accepted that so accurate a botanist as Roxburgh may have failed to recognise the isolation of the Sumatran from the Chinese (and Rungpur) plant, the suggestion naturally occurs, is there any very strong evidence to show that the plant grown in Rungpur to-day is botanically the same as that found by Buchanan-Hamilton in Dinajpur at the beginning of the century? But let me add, Roxburgh never speaks of the plant as having been supplied to him from Dinajpur but from Rungpur*—the district in which Dr. Campbell

RUNGPUR.

Is not Wild.
Cult. with
para. 2-7,
17, 28, 30,
32, 40, 52.

Cultivation
Abandoned.
Cult. with
para. 30.

Revolution
in the
Agriculture
of Dinajpur.

Was
Roxburgh
Right after
all?

* Consult foot-note to para. 22.

SOUMERIA
river.**Districts in which Rhea is Cultivated.****BENGAL**
CULTIVATIONGoalpara.
Cult. with
para. 53.**RUNGPUR.**Lenses to be
learned from
Tobacco
Cultivation.High Class
Agriculture.Tobacco
Trade &
Burmes
Supply.Trade in
Ginger.Rhea has to
compete with
Tobacco and
Ginger.

subsequently found it being cultivated—and Hamilton's specimens in the Edinburgh Herbarium would appear to have been obtained from Goalpara, not Dinajpur. According to Mr. Monahan rhea is not cultivated in Goalpara at the present time, so that here again we have a further possible evidence of change.

45. *Bengalpur*.—One of the most striking features of this district is the extent of tobacco cultivation. Both *Nicotiana Tabacum* and *N. rustica* are grown wherever the soil is a rich sandy loam with water only a few feet below the surface. Wells are dug all over the tobacco fields, and during certain stages in the crop hand irrigation is daily pursued. In fact the water is thrown from the wells so as not merely to supply moisture to the roots, but to wash the dust off the leaves. The agricultural system pursued by these cultivators is of a very high order, and it is not to be wondered at, therefore, that the exports of cured tobacco leaf should be, as I was informed, valued at over Rs10,00,000. But a further circumstance may be here mentioned; practically the whole exports are purchased by Burmans who have settled in the district. The cultivators send their leaf on the field to tobacco curers who are all up-country traders or *Dalals* and the latter sell to the Burman dealers. The leaf is then sent to Burma to be made into cigars. Only the tobacco of fine quality is bought by these dealers, so that the superiority of the Rungpur leaf over that of the rest of Bengal has given origin to the distant industry of manufacturing cigars in Rangoon and Moulmein, a large proportion of which returns to India again to meet the growing demand for Burman cigars. In addition to tobacco Rungpur also produces a large amount of ginger of a very fine quality.

46. The Railway to Jatrapur may be said to cut the district practically in two and curiously enough on the one (the northern) side *Nicotiana Tabacum* is extensively grown, while, on the other, *N. rustica* is very frequently met with, especially in all the low-lying undulations of the soil. But wherever the red clay soil appears tobacco cultivation at once disappears.

Rhea seems to flourish exclusively within the tobacco-growing portions of the district and the plant is most successfully grown where the finer qualities of *N. Tabacum* are produced. I have mentioned these particulars of tobacco cultivation in order to

Dr. Campbell's Discovery.

(G. Watt.)

BEHMERIA
nivea.

pointedly draw attention to the fact that rhea is by no means a plant that can be produced on any soil or under careless and neglectful agriculture. It demands the best soils; the land must be above inundation, but possessed of free sub-soil moisture; the fields have, moreover, to be manured and carefully tended. When such conditions are forthcoming it luxuriates, but without them it is a failure. My experience points directly therefore to localities and soils that are suitable for tobacco as being very possibly suitable also for rhea.

Dr. Campbell wrote of the cultivation of this plant in Rungpur in 1847. He says—

"In the month of January last, when I was returning from the Rhoontan frontier through the district of Rungpur, my attention was attracted by small patches of green crop, cultivated, with much care, close to the villages along the banks of the Teesta River. I had never seen the plant before, in that part of the country it was an object of additional interest. It turned out to be the *kankura*, and is considered by the people to be a species of hemp. It is cultivated with much care."

Thus 40 years after the date of Buchanan-Hamilton's exploration rhea cultivation had been fully established in Rungpur.

47. During my explorations in the Rungpur district I visited so many rhea-cultivating villages that a mere enumeration of these would take up much space and serve no very useful purpose. Around the suburbs of Rungpur itself I found the plant grown here and there, and the following villages may be specially mentioned: Rampara, Saigara, Lalbag, Barabari, Bororghat, Shabda, Shabdapuskerni, and Shampur. A little further afield Ablihat, Burirhat, Jhotaka (30 miles from the town of Rungpur). The village of Kankurapara (in the Kurigaon sub-division) receives its name on account of the extent to which *kankura* is cultivated. There were in that village when I visited it at least 20 cultivators, none of whom belonged to the fishing class. They grow the plant and sell the produce on the field to the fishermen. The plots of land devoted by each cultivator to the crop approximate to what might be called field cultivation. *Kankura* in this sub-division might in fact be regarded as a regular agricultural crop, a state of affairs seen for the first time at Kankurapara, and nowhere else met with on the same scale in my subsequent explorations in Bengal or Assam. At Honnaram near Barabari, cultivation on a fairly large scale was also found, but the plant was reported to be liable to the attacks of a caterpillar that did much

RUNGPUR.

Demand
Careful
Cultivation.
Conf. with
paras. 42,
43, 49-51,
70, 80, 84.

Dr. Camp-
bell's Expe-
rience of
Rhea in 1847.
Conf. with
paras. 10,
112.

Explorations
Conducted by
Me.

Extensive
Cultivation.

Cultivators
not
Fishermen.
Conf. with
paras. 70,
80, 80.

Kankura-
para.

Attacked
by
Caterpillar.
Conf. with
para. 72.

**BOEHMERIA
nivea.****Districts in which Rhea is Cultivated.****GENERAL
CULTIVATION**

injury. The cultivators were *Rajbansis* who sold the produce to the fishermen.

Garo Hills.

48. Crossing the Brahmaputra River to the corner of the Rungpur district that lies just under the Garo Hills, the crop was met with at many villages around Rohmari but, though the neighbouring extensive flat jungles were explored and for some distance up the slopes of the outer hills as well, no trace of wild *Boehmeria nivea* was met with, nor had the people any knowledge of its being a wild plant.

Soil.
Conf. with
pervs. 46,
50, 52, 74,
81, 134, 150,
175, 187,
210.

**Garden
Cultivation.**
Conf. with
pervs. 7, 38,
39, 47, 49,
55, 101, 103.

49. *Soil Required.*—The villages mentioned will serve to indicate that the greater part of Rungpur was visited, and it may be added that the rule already laid down was confirmed on all lands, namely, that wherever a soil of rich sandy loam occurred, there *kantura* cultivation was met with. With the exception of the localities mentioned (in the Kurigaon sub-division), it was, however, exclusively found in small plots around the homesteads and was grown by the fishing class for their own use and not as an article of trade.

BOGRA.

50. *Bogra.*—Having explored the tract of Rungpur and a portion of Goalpara that skirts the foot of the Garo Hills, I recrossed the Brahmaputra and entered the district of Bogra at Jumatan and marched to Modhupur, Mokamtola and thence to Bogra Station. Having visited many villages *en route* where rhea was being cultivated (and which is here called *kund*) I next explored the neighbourhood of Bogra itself and worked my way back again to the river at Nokhila, as I was assured the whole country on the other side of the district (west and north toward the railway) had a red clay soil and no rhea cultivation. I was much struck with a change in the agriculture of the alluvial tracts of this district. Tobacco had to a large extent disappeared and its place been taken by extensive fields of *Capsicum frutescens* (chillies) and *Ipomœa Batatas* (the sweet potato). I had never seen either of these as field crops before and was greatly pleased with the red chillies since they gave a bright effect to the otherwise monotonous scenery. With the disappearance of tobacco, rhea cultivation became scarce and of a very indifferent quality. On nearing the border line of the alluvial and red clay soils both crops were ultimately lost and their places taken by the elevated narrow fields (or rather ridges) on which the mulberry is cultivated.

**Local Name
*Kund.***

Rhea will not
grow on Red
Clay.

Chillies and
Sweet
Potatoes

Mulberry
Beds.

B. 576-606.

Jalpaiguri and Kuch Behar.

(G. Watt.)

BOEHMERIA
nivea.

51. The only point of additional information learned in Bogra regarding rhea was in connection with the cleaning of the fibre. The samples of clean fibre shown to me were of a rich golden yellow colour. On enquiring the reason I was informed that the dry fibre after being stripped from the stems is at once dipped into a boiling solution of *haldi* (turmeric) for a few minutes. This was said to soften the fibre very greatly and to thus assist in the cleaning process.

52. *Jalpaiguri*.—Taking train from Kurigaon I proceeded to Jalpaiguri. From there I skirted the Duars and marched to Falakata, thence to Alipore and Kuch Behar, a distance of 84 miles. On that route many rhea-growing villages were visited and occasionally the plant was found to receive the name of *kurkund* not *kantura*. Very little additional information was, however, obtained. Everywhere it was grown around the homesteads. On the banks of the Teesta few, if any, fishermen's house could be found without its small plot of this plant. The road led through extensive jungle tracts, but though constantly searched for, not a trace of *B. nivea* could be found in a wild state. On one occasion a cultivator told me that he had seen it wild at a certain village. A detour was at once made of some miles off the route only to be once more disappointed. The plant was *B. platyphylla*, which the cultivators assured me, though now wild, had been grown on account of its fibre, and that the fibre, while inferior to the *kantura*, was a good one for fishing lines and nets.

53. *Kuch Behar and Bhutan*.—The jungles that skirt the foot of the Bhutan Hills were examined as far as time would admit, but with the same result, *B. nivea* was not found wild, though in the villages here and there, the usual small plots near the houses occurred. In Kuch Behar a good deal of rhea was also met with, one or two fields being within the town itself. But the following statement occurs in an official letter (No. 204, dated 2nd August 1870). "A plant supposed to be rhea grows wild in the hills of Darjeeling, Goalpara, and probably throughout the Duars of Bhutan, and can be propagated, it is believed, to any extent." Whatever may have been meant by the above it was not rhea, at least I have no hesitation in saying so from my personal explorations of the greater portion of the regions mentioned. I have never in all my ramblings, which have extended now

JALPAIGURI.

Fibre
Cleaning
Chemicals.

Conf. with
papers, 31, 32,
33, 73, 80,
102, 103.

Local Name
Kirkund.Not Found
Wild.

Conf. with
papers, 6-7,
41, 42,
44, 60.

KUCH
BEHAR.

Goalpara.
Conf. with
papers, 39,
44, 50.

SCHEMERIA RIVER.

Districts in which Rhea is Cultivated.

GENERAL CULTIVATION.

for over 25 years, come across a wild plant of *B. niven*. But Mr. Monahan in his *Note on Rhea Cultivation in Assam* says that the plant is not met with at all in the Goalpara district. I have not personally visited Goalpara, but there seems no sufficient reason for thinking that it should not occur since it is cultivated in Kach Behar and Kamrup—on both sides of Goalpara. The distribution of the plant is, however, very erratic, and it is probable Mr. Monahan may be correct though the circumstance is certainly very peculiar.

54. *Other Districts of Bengal—Bhagalpur* is mentioned by writers on rhea, but I have not been able to visit it in connection with this enquiry. Among the papers put up by Government in 1879 for the guidance of the Commissioners appointed to examine and report on the rhea fibre-extracting tests at Saharanpur, mention is made of the district of Bhagalpur. Colonel H. H. Stansfeld, Private Secretary to His Honour the Lieutenant-Governor, wrote:—

"It may be of interest to His Honour to know that the fibre has been prepared many years ago at Bhagalpur by some families of the Dhanoo caste for the silk weavers there." So again it is stated by Messrs. Thomson and Mylne (*letter 24th September 1879*): "The method for obtaining the fibre practised by certain natives of Bhagalpur of the Dhanoo caste, some eight or ten years or still further back, is generally as follows:—

"The site of the little factory is chosen, if possible, near a stream of water, as the process is one of slow boiling or simmering, and beating a combination with washing.

"The factory plant is an earthen or other pan or boiler, and two notched boards such as dhobies use.

"The work people, two men, two women, and two boys.

"The boiler is charged with water sufficient to cover the shoots proposed to be dealt with, and to it is added about 10 chuttacks *suggie malle* (crude carbonate of soda) per maund of plant placed in the boiler, the whole is then allowed to simmer or boil slowly for 1½ or two hours.

"The shoots are then taken by or handed to the nearest man with a notched board before him, (the boards being placed near by or partially in the water *dhobie* fashion) in such portions as can be held firm between his two hands he continues to dash it against the board washing it at the same time, thus clearing each end alternately of the wood and portions of the bark and gum. The handful is then passed on to the second man with a similar board who beats and washes it in the same way to free the filaments still farther from gum and bark.

"After this it is taken by the boys back to the boiler to be again slowly boiled or simmered for about an hour. It is then again beaten and

Fibre
Prepared
many years
ago.

Mixed with
Silk.
Conf. with
parras. 13,
204.

Method of
Cleaning
Fibre.
Conf. with
parras. 51,
78, 104.

Boiled in
Carbonate of
Soda.

Beaten on
Boards under
Water.
Conf. with
parras. 100,
103.

Boiled a
Second Time.

Bundabanda.

(G. Watt.)

BCHMERIA
Rives.

worked by the two men as before till the gum is removed, and the filaments are free.

"The two women now take charge of it to be dried, beaten and drawn or carded till it is in the condition of the accompanying sample but much whiter.

"A census of shoots per hour can thus be easily worked off, which, if filament is in the plant in the proportion of 2½ per cent., will be one seer of fibre fit for the spinning by the native hand method or for carding machine if sent to Europe. If the percentage of filament in the plant is over 2½ per cent., the outturn will be increased in proportion while no addition is made to the cost.

"By adding half the original quantity of *sujjes matee* to hot water in the boiler it may be used again afterwards, the water should be changed." (*Jour. Agri-Hort. Soc. Ind. (N.S.) VI., 172.*)

55. I have not been able to discover whether the fibre is still being cultivated in Bhagalpur, but Mr. T. Sandys in a letter to the Bengal Government would seem to throw some doubt on the accuracy of the information. "I beg to state," he says, "that I know nothing of the Dhanook party, now said to have removed to Synthia." He then goes on to explain that he obtained the stock of plants cultivated by him from "Chowringhee, Purneah, Dinajpur and Rungpur." So far as my investigations go rhea does not occur in Purneah at all—or rather it is not grown by the Natives—and it is only met with in a few villages in the extreme north corner of Dinajpur, that might more properly be described as Rungpur. But Mr. Sandys' experience in the cultivation of the plant is in full accord with all I have written and may be here quoted:—

"I have met with great reverses in the cultivation, the difficulties of which I regard as secondary if not equal to those for the extraction of the fibre. Nothing but the highest state of garden cultivation will answer. Will this pay? I think it will, provided that an economic organised system is pursued from the planting of the cuttings until the fibre is woven into cloth, or otherwise. I cannot speak positively on this point, as it has not been worth my while to try it as yet on a proper scale." "Rhea from the character of the plant must be grown on high lands in contradistinction to submerged lands."

Mr. T. Sandys' further remarks on the danger of white-ants are well worthy of careful consideration. He says.—

"After harvest cuttings they (white-ants) attacked the woody portions of the stem, thus left exposed, and burrowed downwards inside the roots

BUNDABANDA.

Carded.

One maul (80 lbs.) an hour can be cleaned.

Mr. T. Sandys' Experience.

Experience in Cultivation.

High Garden Cultivation Essential. Conf. with paras. 48, 49, 52-5, 53.

White-Ants an Enemy to Rhea.

Conf. with Report, Ten Pests and Blights, pp. 340-349.

**SCHEMERIA
niven.**
Recapitulation Regarding Bengal.
**BENGAL
CULTIVATION.**

completely honeycombing them of their pith, leaving nothing but the bark untouched. They eventually attacked all weaker plants of all ages." (*Jour. L.C., pp. 175-6.*)

In an official communication (*No. 204, dated 2nd August 1870*) it is stated, "The Rhea plant is not indigenous to any part of this district. It can, however, be grown everywhere with more or less cultivation."

But with these statements of a more or less ancient cultivation and of a use for the fibre in admixture with silk before one, it is difficult to see how so careful an investigator as Dr. Buchanan-Hamilton could have said that he had met with the plant in Dinajpur only. We are, I venture to think, forced to believe that the Bhagalpur Rhea Industry may have been very recent, and perhaps only temporary, and not instituted by Europeans. But as I have not visited Bhagalpur, I must allow this somewhat conflicting statement to stand side by side until more definite particulars are forthcoming.

Sunderbunds.

56. *Sunderbunds.*—"The Rhea plant is unknown here, except in Messrs. Morrell's estate in the Jessore portion." "Mr. Claria, Superintendent of the Botanic Gardens, feels pretty sure that the plant is not to be found in the Sunderbunds wild." The above has been taken from an official report dating back to 1870. Personally I have botanised over a good portion of the Sunderbunds (e.g., Khulna, Backergunge and Noakhali), and I certainly never came across the plant, either wild or under cultivation. The water-logged nature of the sub-soil for a great part of the year would seem to render this area a most unlikely one for a future Rhea industry. I visited Messrs. Morrell & Co.'s estate, but their present manager assured me the experiment had long since been abandoned.

Patna.

57. *Patna.*—The Commissioner wrote (*No. 287, dated 6th August 1870*) that "the plant does not grow in any district of Patna. Any profitable culture is precluded by the general dryness of the soil and unsuitableness of the climate."

Orissa.

58. *Orissa.*—The plant is stated to be unknown.

**CONCLU-
SIONS.**
Recapitulation of Conclusions Regarding Rhea in Bengal.

59. Having thus briefly indicated the extent of my personal investigations into the *Rankura* districts of North Bengal, and here a few passages to show the practical absence from the other districts and divisions of the Province, I shall now endeavour to bring

Recapitulation Regarding Bengal. (G. Watt)

BOEHMERIA
Diver.

together a few of the more instructive facts thus brought out, of a practical nature, regarding the cultivation of the plant. The following may be admitted as fully substantiated:—

60. *Is not Indigenous.*—The plant is not a native of the districts of North Bengal. Its acclimatisation has not been carried to the extent of the plant having found its way into the jungles as a weed. From abandoned cultivations it is rapidly exterminated by the indigenous weeds. (*Conf. with paras. 18, 27, 29, 43.*)

61. *Local Peculiarities.*—Its restriction as a fibre crop to certain districts of North Bengal, points to the existence in these of favourable conditions very possibly not present in the greater part of the rest of the province. But its profitable production as a commercial fibre is not even possible within every part of the districts where its cultivation is pursued.

62. *Soil Required.*—It requires a rich alluvial soil (a sandy loam) and cannot be profitably grown on clayey soils, nor on inundated tracts such as are suited for rice and jute.

63. *Limited Cultivation.*—But the fact that it is not universally grown by the fishermen throughout India on the alluvial basins of all rivers, points conclusively to the necessity for other conditions than merely a rich soil of sandy loam. Even within Rungpur, which may be regarded as the head-quarters of the Rhea production of India, there are large tracts to the south where the people admit freely that the plant cannot be profitably cultivated, or where only a very inferior fibre can be produced.

64. *Conditions of Cultivation.*—It commands the finest lands; a liberal sub-soil moisture or extensive irrigation; the greatest possible attention and protection from cattle; a high amount of manure; and, while given all these conditions, the plant will produce an abundant crop; the fibre is troublesome to separate and the crop accordingly unpopular.

65. *Possible Expansion.*—Rhea has to compete with tobacco, ginger, cayenne, and other such highly profitable and convenient crops, and the land suitable for its cultivation is already very largely occupied and would be expensive. Unless, therefore, a great reduction in cost of cleaning the fibre or a much higher price can be secured for the article than at present, there would seem little prospect of the native cultivation being materially extended, or of Rhea

CONCLUSIONS

Important
Fact
Regarding
Bengal
Rhea.Is not
Indigenous.Conf. with
paras. 6-7,
41, 49, 44,
50, 77.Restricted
Area.Conf. with
paras.
47, 50.

Soil.

Conf. with
paras. 40,
46, 50, 81.Cultivation
Limited.

Conditions.

Conf. with
paras. 45,
50, 55, 83.

Expansion.

Conf. with
paras. 48,
46, 50.

Price.

Conf. with
paras. 3, 4,
9, 43, 61,
83, 84, 130.

**BHEMERIA
RHEA.****Recapitulation Regarding Bengal.****BENGAL
CULTIVATION.**

Direction.
Conf. with
pages, 17,
26, 28, 29,
120 (d).

**Sub-montane
Tract.**

Latitudes
of Rhea
Cultivation.
Conf. with
pages, 113-4,
120 (d).

**Expansion
to the South
improbable.**

production becoming a remunerative occupation for European labour and capital.

66. Probable Direction of Expansion.—The most hopeful prospect of a future expansion may be said to lie within its present area in North Bengal. The overflow might then be looked for to pass east and north-east into the valley of Assam rather than to go to the southern and south-western or south-eastern districts of Bengal. In fact it would almost appear as if there had been a migration north-east since the date of Buchanan-Hamilton's explorations in 1827. Its suitability to the Rungpur and Jalpaiguri districts and to the Duars would point, however, to a possible expansion westwards toward Tirhut. In other words, it would almost seem as if the Indian Rhea cultivation might become distributed within the belt of districts which, starting in the extreme east-north-east in Lakhimpur and passing through Sibsagar, Darrang, Nowgong, Kamrup, Goalpara, Kuch Behar, Rungpur, Jalpaiguri and the northern extremity of Dinajpur, passes still west to Purneah, Bhagalpur, Durbhanga, Muzafferpur, Champaran, and possibly also to Saran. The sub-montane character of this tract of country, skirting as it does the foot of the Bhutan, Sikkim and Nepal Himalaya, may be at once admitted as very possibly possessing many physical and meteorological characters in common. It may be said to lie between $25^{\circ} 30'$ and 27° north latitude. But how far a western expansion may be possible the future alone can reveal; no difficulty would seem to exist against an eastern distribution except perhaps the labour question which is so very serious in Assam.

Rungpur lies right in the centre of the region indicated, and, as already stated, the crop was found to attain its greatest perfection on the north and the north-eastern divisions of that district—the portions that may be said to face eastwards toward the Brahmaputra valley.

67. Southern Districts Unfavourable.—In Bogra the crop could alone be said to be important in the northern and north-eastern portions. The clay, rice lands, to the south and west, viz., those that adjoin Dinajpur and the Rajshahi, were found to contain no Rhea. So in a like manner in Dinajpur itself only the most northern extremity of the district, viz., that portion which adjoins Rungpur or penetrates between Jalpaiguri and Purneah, could be said to have Rhea.

B. 576-606.

Vegetables of Rhea Area.

(G. Watt)

BEHMERIA
River.

68. *Vegetation of Rhea Area.*—It would very possibly detract from the prominence I desire to give to the fact that Rhea cultivation is confined within the belt of sub-montane districts indicated, were I to attempt to furnish a full statement of the characteristic features of the vegetation of that country. I shall therefore confine myself to a few of the more significant points that seem to me to be very possibly due to the same causes that give a special adaptability for Rhea cultivation. After crossing the Ganges at Saraghat the visitor to North Bengal would very possibly be at once struck with the rapid disappearance of the distorted thorny trees of *Acacia arabica* that are so very characteristic of the southern districts of the Province. At first they are seen only here and there until a point that corresponds with the middle of Dinajpur is reached when they practically disappear. The *Acacia* belongs to the great Natural Order of Leguminosæ, a group of plants that includes the vetches, peas and beans. On directing attention to the fields within the area of Rhea cultivation, it will be seen that with the exception of *Crotalaria juncea* (Sunn Hemp) there are remarkably few leguminous crops. The people of North Bengal accordingly use a very much smaller amount of pulses in their daily diet than do the people of the rest of Behar. But they make up for this defect by the consumption of a very much more varied series of *sags*, or green vegetables. As Buchanan-Hamilton has told us, they eat the leaves of the Rhea plant itself, and, I may add, they regard its abortive flowering spikes as a great delicacy, and these in point of flavour are said to resemble the cauliflower.

Every cultivator has what might be called a vegetable and fruit garden—a state of affairs hardly met with in any other part of India. And what is most significant these enclosures around the houses contain an assemblage of plants peculiar and characteristic to the Rhea area. I shall mention the more striking examples of green vegetables by way of illustration and in order of abundance:—

1. *Malva verticillata*, L. This mallow is universally grown from Rungpur, Jalpaiguri and Kuch Behar to Upper Assam, and even finds a place in the vegetable gardens of Europeans. It is known as *lopha sag* and the leaves are eaten.

2. *Chrysanthemum coronarium*, Linn. This very elegant yellow flowered *Chrysanthemum* is universally grown as a vegetable. Botanists tell us it is a native of the Mediterranean region, but

CONCLU-
SION.Vegetation
of the
Sub-montane
Region of
Rhea.Distribution
of the *Acacia*
Tree.Few
Leguminous
Crops.Gardens
Around the
Homesteads

Mallow.

Chrysan-
themum.

BEHMERIA
nivea.

Method of Cultivation.

GENERAL
CULTIVATION.

every cultivator knows it by the name *bahr*. I have never seen this in any other part of India, and it is perhaps the most striking plant of the region.

Sorrel.

3. *Rumex vesicarius*, Linn. While this sorrel occurs here and there very occasionally in gardens to the south of the region indicated, it is so very abundant and in such frequent association with the others, that it may be specially mentioned in this connection. It is an extremely handsome plant and should find a place in ornamental flower gardens even if its merits as a green vegetable do not commend it to consideration.

Buckwheat.

4. *Fagopyrum esculentum*, Moench. This plant instead of being grown for its seed (buckwheat) is raised as a vegetable. It is most generally known as *phaphra* and in Assam as *doron*.

Chinese
Cabbage.

5. *Brassica* (*Sinapis*) *cuneifolia*, Roxb. In nearly every one of these vegetable gardens, specially in Assam, a species of *Brassica* is grown as a vegetable. This has a rosette of ground leaves generally of a dark bluish-green colour and with very broad yellow mid-ribs and leaf stalks. When young it looks not unlike a cabbage and is, I presume, not very remote botanically from Chinese cabbage. In time it shoots up a much-branched inflorescence to a height of four to six feet. This becomes clothed with numerous sessile (stalkless) leaves. All parts are eaten, more especially the young flowering shoots, with their delicate leaves.

Lai-hak.

This plant seems to have escaped the consideration of economic botanists and gardeners alike. It is one of the most significant and elegant of vegetables and there are probably several easily recognizable forms. At all events I found some with glaucous leaves covered with a white waxy powder and others pale-green and devoid of the waxy coating. It is generally known as *lai-hak* which might be translated mustard-*sag* *i.e.* vegetable.

Wild Plants
of the Region.

It would occupy too much space to develop this list further, but let me add there are just as many significant features in the wild vegetation of the rhea area, as in its field and garden crops. My present purpose has been served by the above brief notes, namely, the exemplification of striking peculiarities sufficiently marked to justify the conclusion that there are present conditions and peculiarities that very possibly are intimately associated with the restriction of successful cultivation of rhea to the tract of country I have indicated.

Output and Cost of Production. (G. Wall.)

BEHMERIA nives.

6. *Method of Cultivation.*—In Bengal rhea is propagated by root cuttings, though the system of burying horizontally stem cuttings is sometimes pursued, more especially to fill up vacancies and to increase the number of plants in the fields. The cuttings are usually 6 to 9 inches in length and planted under 3 to 4 inches of soil. They are placed from 1 to 3 feet apart each way. There are said to be two seasons for transplanting, the *first* in April to May (before the commencement of the rains), and the *second* in September to October (at the close of the rains). The majority of cultivators seemed to favour the former season.

The fields are weeded and hoed after each cutting and heavily manured every year during the cold season. Unless very heavily manured, the plants should be transplanted into new plots of land after two, three, or four years, depending on the fertility of the soil.

7. *Number of Cuttings.*—The shoots are cut down when the bottom portion of the stem begins to turn of a brown colour. At this stage the leaves, low down on the stem, also begin to fall off. Two to four or even five cuttings are obtained a year, the shoots being from four to five feet in height. The majority of cultivators gave three cuttings as a good average crop. Two cuttings they regarded as indicative of neglectful cultivation, and five or six they said can only be obtained from very small plots shaded, heavily manured, and freely watered. As a rule the entire plot is cut down at one and the same time, but occasionally the more intelligent cultivators remarked that they select the stems when ripe and thus practically only cut small quantities at a time but throughout the year.

From September transplanted plots, the following were given as the season for cutting:—

1st Cutting in May (the worst cutting). 2nd Cutting in June (the best cutting). 3rd Cutting in July. 4th Cutting in August.

But many cultivators seemed to prefer to reject the May cutting and to use it for green manuring the plot, thus having only three cuttings.

If transplantation takes place in April-May there are usually only the three cuttings those already indicated. A cutting made later than August is regarded as affording a very inferior fibre. Many cultivators nevertheless cut down the plants once or twice during the cold season but with a view to cause a vigorous shooting simultaneously for the June cutting.

CONCLUSIONS.

Methods of Cultivation.
Conf. with papers, 25, 27.

Seasons.
Conf. with papers, 25, 27, 28.

Weeding and Hoofing.
Conf. with paper, 27.

Length of Shoots.

Conf. with papers, 79, 83, 85, 100, 104, 143, 145, 164.

Number of Cuttings.

Conf. with papers, 79, 80, 86.

Chief Seasons.

Green Manuring.
Conf. with papers, 80, 100.

BENNERIA **nivea.**

Price of Fibre.

GENERAL **CULTIVATION** **Outturn.**

71. Outturn and Cost of Production.—So contradictory were the figures furnished from day to day by the cultivators, that I gave it up as hopeless to attempt to form any definite conclusions. It seemed to me that the only satisfactory way to arrive at opinions that could with any degree of assurance be given to the public, would be for the Government, without any warning, to arbitrarily purchase (not preferably in the Kurigaon sub-division of Rungpur) the crop as found on two or three plots in various villages at each of the above seasons and to reap the stems at once and separate the fibre by machinery or otherwise. Were careful returns preserved of the sizes of each plot (if not of the actual number of plants as well), the weight of the green stems, and the weight of the clean dry fibre or of the ribbons, it might be possible to form an opinion as to the yield per acre. One of my Bengali assistants, during our tour through the rhea districts of the province, made careful enquiries at one or two villages and he gives me the following as the result. I publish his conclusions mainly with the object of showing the value, if any, that can be placed on all such returns :—

"The only information I could get about it from two rhea fields at a village near Barobari, in Rungpur, is given below. The cultivator, Sukalu Das, obtains 32 seers (60 tolas = 1 seer) of fibre a year from a part of land which estimated at the acre would produce 6 maunds, 21 seers (80 tolas = 1 seer), or 535 lb. Another cultivator, named Manram Das, obtains 15 seers (60 tolas = 1 seer) of fibre from a plot of the area of 100 square yards. Therefore 1 acre of land would yield 7 maunds, 5 seers (80 tolas = 1 seer), or 584 lb. Even these quantities would only be available if the fields are well treated. A well-cared-for plantation may last for several years—'for ever,' said one of the best cultivators.

"Rhea fields are liable to the attack of a kind of caterpillar which eats through the roots of the plants. This caterpillar is called by the cultivators of Rungpur *malpoka*. The *malpoka* causes so serious damage to the plantation that the plants wither away within a year or two. When this pest is noticed, the roots of the fields are transplanted. New plantations, it is said, would get on well for three or four years.

"The price of the fibre in Jalpaiguri is Rs 1 to Rs 1-8-0 per seer (80 tolas = 1 seer), in Rungpur and Bogra Rs 1 to Rs 2-8-0 per seer (80 tolas = 1 seer). Thus 1 acre of land would produce about Rs 0 to nearly 400 or at most 650 rupees worth of fibre per annum according as it was valued at Rs 1 or Rs 1-8-0 or Rs 2-8-0 a seer. In the English market the rhea fibre may be sold at £50 a ton (*vide* Dictionary of Economic

Yield.
Conf. with
para. 70.
80, 81, 83,
85, 86, 88-
106.

Diseases.
Conf. with
para. 47.

Prices.
Conf. with
para. 3,
4, 9, 43, 65,
81, 83, 84,
103, 106,
140.

B. 576-606.

Separation of Fibre.

(G Watt)

BOEHMERIA
nivea.

Products of India, article on *Boehmeria nivea*), or about 6 annas a pound, which is much less than the price in North Bengal.

"It was found impossible to get information about the cost of production. I was told by the best cultivators that they might gain a little if the cost of labour for separating fibre could be reduced. It is said that one man can hardly manage to cultivate more than 230 square yards of land. If so, 21 men would be required for the plantation of 1 acre of land. The wages for 21 men for one year would exceed \$1,000. My conclusion shows that the value of the estimated outturn of an acre of land is less, by far, than the estimated cost for production. But, in my humble opinion, the number of men stated, is likely to be required only for the occasional operation of separating fibre."

2. *Separation of the Fibre.*—It is customary to wait for the appearance of fine weather before cutting the crop. The stems require to go through a process of drying, and rainy weather or even cloudy days during the drying stage are supposed to injure the fibre. The shoots are at once stripped of their leaves and the leaves very generally returned to the field as manure. The shoots are then carried to the dwellings of the cultivators and by means of a bamboo knife or scraper are deprived of the bark and the green succulent outer tissue around the fibre. It is regarded as essential that all the plants should be scraped or decorticated within 24 hours after being cut. The stalks are then laid out on the ground in some dry situation and exposed to the sun during day and removed within doors at night to avoid the dews, and this method of drying is continued for some 4 to 10 days. The stems are thus completely dried and the adhering fibre more or less bleached. The stems are then each broken across, a little below the middle. The finger or scraper is then inserted underneath and is run upwards and downwards until the whole of the fibre is removed. For this purpose the central stem may have to be broken more than once.

This stage is considered the most troublesome of all. After being removed from the stem, the fibre is once or twice drawn rapidly through between the scraper and the flat surface of the fore-finger, in order to free it from any adhering particles of the stem or bark. But the shoots are in no way subjected to steeping as stated by Dr. Buchanan-Hamilton. The process seen by me in Bengal is in substance that briefly stated by Buchanan-Hamilton (*para. 39*) except in the matter of steeping. The after cleaning of the fibre, preparatory

CONCLUSIONS.

Cost of Production,
Conf. with
paras. 34,
51, 53, 57.

Expense of
Production.

Separation
of Fibre.
Conf. with
para. 51,
54.

Stems
Scraped.
Conf. with
para. 70.

Drying the
Stems.
Conf. with
paras. 70,
59, 56, 100.

Cleaning
the Fibre.

BENNERIA river.

Industrial Uses.

GENERAL CULTIVATION

Chemicals
not used.

Fibre
softened
by being
boiled in
Rice Water.
Conf. with
para. 50.

Uses of the
Fibre.

Markets
where Fibre
may be
Purchased.

Ribbons not
Made in
Bengal.
Conf. with
para. 23,
43, 56, 57.

to its being spun into thread, is done for the most part by the women and children and consists entirely in cleaning and spinning up the fibre by means of the fingers. The system of boiling in *sujee matee* (or crude carbonate of soda) described above in connection with Bhagalpur (para. 54) I nowhere found being followed. But as already mentioned in connection with Bogra, the fibre is sometimes dipped for a few minutes into a boiling solution of *haldi* (turmeric) from the idea that it is thereby softened and rendered more easily separable into the fine bands of fibres required by the fishermen. In one instance, I was in Bogra told that the partially cleaned fibre was boiled for a very short time in the water obtained after cooking rice. This was also said to soften the fibre. It is probable that in both illustrations the advantage secured has been exclusively obtained through the act of boiling the fibre. At the same time it would seem desirable that the action of both rice water and turmeric should be chemically investigated.

73. *Industrial Uses*.—With the single exception mentioned above in connection with Bhagalpur (para. 54), I came across no person who was aware that the fibre could be spun into such fine yarn that it might be woven into fabrics. In the case of Bhagalpur it is stated that it had been used some twenty years ago in admixture with silk. Whether it is still so employed I have been unable to discover, but throughout Bengal and Assam it is spun into coarse threads, three strands of which are again spun together to make fishing lines and the cord from which the *kai jalas* or fishing nets are made.

I heard of one or two markets or annual fairs at which the fibre, the cord, or the nets of reed were regularly offered for sale, such as the *Bora Daroga mela* and the fair at Kaunia.

74. *Ribbons*.—But there is one point I desire to pointedly draw attention to in this place. I never in all my wanderings came across an instance in Bengal where ribbons with their adhering bark were stripped off and either subsequently cleaned or dried and sold in that state. It is customary to find in reports published in Europe the statement that ribbons are exported from India. I cannot say definitely that that may not be so, but I should think it highly likely that the supply must be exclusively derived from European experimental plantations or prepared to order. The Bengal cultivator invariably scrapes off the bark before separating the fibre from the stem, and

Discovery of the cultivated Plant. (G. Watt)

BOEHMERIA
nivea.

that offers for sale what may be a crudely cleaned fibre (China-grass), but it is, certainly, not the much condemned "Indian rhea ribbons" that have given an evil name to, and greatly lowered the value of, the Indian fibre.

75. *Machinery*.—The Bengal cultivator, strictly speaking, decorticates first, then strips the fibre, and it seems to me his process is a more rational one than that followed by each and every one of the inventors of the so-called decortivating machines hitherto made known. These simply either strip off the bark with its adhering fibre or smash up the contained stem (scutching) and liberate the bark and fibre in that way. Some of them by a subsequent action no doubt get rid very largely of the adhering bark, but they fall far short of the operation of complete removal of the bark, and green papy external tissue that is immediately effected by the cultivator on the stems being cut. Whether his subsequent process of drying the exposed fibre before separating it from the stem is advantageous or not I have not had the opportunity of testing, but long experience with the Indian cultivator has prejudiced me in favour of the view, that he rarely does much within his own sphere of life that is useless, and he certainly never imposes on himself very considerable additional labour to no purpose.

CULTIVATION IN ASSAM.

76. *History*.—It has been already stated that the earliest mention of this plant in connection with Assam occurs in a letter from Captain Jenkins, dated January 1833. Modern writers have discounted the reports and letters furnished by Jenkins, Dalton, Hannay, Masters, and other early Assam explorers, when they have affirmed that these writers have stated that *Boehmeria nivea* (variety *tenacissima*) is indigenous to Assam. Subsequent to the date of the discovery of the cultivation of rhea in this province a wild plant, which yields a remarkably strong fibre and which is called *bon-rhea* (wild rhea) was found. Although none of the early investigators made the mistake of confusing these two plants, their less careful descendants and compilers have done so, until the statement of rhea being indigenous to Assam has become current in the literature of the subject. *The Dictionary of Economic Products* was by express instructions of the Government of India intended to be a compilation of all existing information regarding the Economic Products of this

CORCLU-
SION.

Decortication
before
stripping.
Conf. with
paras. 73,
75, 80, 84.

Decortivating
Machinery.
Conf. with
paras. 73,
83, 84, 87,
89-91.

Drying Fibre.
Conf. with
paras. 73,
75, 80, 84.

ASSAM.

Discovery
by Jenkins.
Conf. with
paras. 79,
89.

Bon Rhea.

The Account
of Rhea in
Dictionary
of Economic
Products.

RHEA
nivea.

Early Mistakes.

ASSAM.

Existing
Conditions
not investi-
gated.

Reward for
Machines.
Conf. with
paras. 226-
228.

Plant not
indigenous
to India.
Conf. with
paras. 6-7,
51, 42, 44,
52, 60, 76,
83.

No Record
of its being
Wild.

Mishmis
supposed to
be Earliest
Cultivators
of Rhea.

country. Before the date of having prepared the account of rhea given in that work, I had not had an opportunity of botanizing in either North Bengal or Assam. Moreover, I could not omit from the Dictionary opinions of distinguished investigators, simply because they might be opposed to my own views. The present report will be understood, therefore, as the outcome of personal investigations and accordingly should be regarded as superseding my previous writings on this subject. I make this statement because I am fully aware of holding opinions now that in certain directions are opposed to the statements I previously advanced regarding rhea in Assam.

77. *Definite Information.*—There would seem no doubt that when the Government of India offered a reward of £5,000 for a rhea fibre-extracting machine to fulfil certain conditions, it would have been advantageous had the idea occurred at the time to those in authority, to have a survey made of the reputed areas of rhea production. Indian botanists had not specially investigated the forms being grown nor whether or not the plant was indigenous to India. Botanical writers in Europe could hardly, therefore, have been expected to pointedly correct the misconceptions that prevailed in India. But in the *Flora of British India* Sir J. D. Hooker gives the name of this plant in the type used for introduced plants, and he says of it, "Cultivated in the warmer parts of India, specially Assam and Bengal." It may, therefore, be now accepted that the old error of viewing it as indigenous to Assam has been authoritatively corrected. Jenkins, Masters, Griffith and other early botanists make no mention in any one of their numerous contributions to scientific journals, etc., of their having met with it in Assam in a wild state. There is not a suspicion even of any of the numerous specimens preserved in the Herbarium of the Royal Botanic Gardens, Calcutta, of having been collected from a wild source. All are definitely stated to have been culled from the cultivated plant.

But speaking of the early history of this plant Dalton says of the Mishmis that—

"They were probably the first people on this side of the Himalaya to discover the valuable properties of the *Rhea nivea* (sic.), and many others of the nettle tribe; with the fibre of one of these nettles they weave a cloth so strong and stiff that, made into jackets it is used by themselves and by the Abors as a sort of armour."

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Colonel Hannay's Report.

(G. Watt.)

BOEHMERIA
nivea.

It seems probable that the jackets to which Dalton alludes were made, not of rhea, but of *San-riku* (*Villebrunea integrifolia*). At all events that is the fibre which at the present day is woven into garments by most of the hill tribes of Assam. The Angami Nagas use largely the fibre from *Girardinia heterophylla*, but neither the aboriginal hill tribes nor the more civilized inhabitants of the plains weave the fibre of *Boehmeria nivea*.

75. But to return to the more instructive historic facts regarding rhea in Assam. Captain Jenkins in a letter to Dr. Wallich, dated 25th July 1836, refers to the fact that the plant—

"Does not bear to be flooded" but a little further on he adds, "It occupies high lands of little or no value. It, however, occupies the land constantly; against this there is the set-off, that it requires little or no cultivation."

It is somewhat difficult to understand what Jenkins could have meant by rhea requiring little or no cultivation since his contemporaries all speak of it as necessitating a rich soil and constant attention. Masters in a memoir on the natural productions of the Angami Naga country (*Journ. Agri.-Horti. Soc. Ind., VI. (1848), p. 44*) refers to it as "The common Rhea of Assam. *Urtica nivea*, which is cultivated by the *Dooms* for net twine." Major S. F. Hannay in a paper on "The Rheas or Nettle Grasses" (*Jour. Agri.-Horti. Soc. Ind. Vol. VII. (1850), pp. 215-25*) gives much useful information on this subject. In fact the present brief historic sketch of the discovery of the crop in Assam and of the early knowledge regarding its cultivation, would be incomplete without full justice being done to Major (afterwards Colonel) Hannay, and since the report of his experiments may not be readily procurable by most persons it may be as well if I quote the greater part of it in this place.

79. *Methods of Cultivation Recorded by Early Observers.*—Colonel Hannay tells us that—

"The sole cultivators of this plant are the *Dooms* or fishermen, who use it chiefly in making their nets; they cultivate it in very small quantity, however, and as the fourth crop is that which bears seed, and they cut it down before the seed is formed, the plant is propagated entirely by dividing the roots. The ground is a small plot close to their huts which they have good opportunities of attending to, and manuring well with ashes and cowdung, a quantity of which is essential to the proper growth of the plant."

HISTORY.

See Bham.
Conf. with
para. 191.

Angami
Nettle Cloth.

Wallich
identifies
Assam Rhea.

Conditions
of Soil
Conf. with
paras. 88,
89, 90, 91.

Colonel
Hannay's
Practical
Experience.

Seeding.

Conf. with
paras. 17,
28, 31, 33.

Well
Manured.
Conf. with
para. 31,
32.

BOEHMERIA
 nivea.

Colonel Hannay's Report.

AREAS.

Number of

Cuttings.

Conf. with

parks. 70,

71, 72-80,

81, 82, 83,

84, 85, 86,

87-100.

Measured

in

February.

Height

of Crop.

Conf. with

parks. 100.

Fenced in.

Seasons of

Cutting.

Conf. with

parks. 70,

80, 86.

Hoeing

Necessary.

Number of

Shoots to

the

Root.

Conf. with

parks. 70,

84, 86.

Yield of 12

maunds an

Acre.

Conf. with

parks. 34,

71, 72-80,

81, 82, 84,

85, 87, 89,

90, 92-100.

"I have mentioned four crops, but as I have now a crop, the fifth, since planting, fit for cutting in February 1851; and I see others belonging to the *Dooms* in the same state, there will be five crops since planting, or six crops from April to April; the last or cold weather crops cut in February, being considered to produce the strongest fibre. However, as moisture seems so essential to the quick growth of the plant, generally speaking, after the early November, or fourth crop, the *Dooms* allow the cattle free egress into their plots and it is thus kept down until February, when some pains are taken in opening out the roots, heaping up the earth, and manuring them as well as enclosing afresh the plot of ground. The soil from repeated manuring is of course rich, and on this, and a great degree of shade and protection from storms, depends the luxuriance of the crop, which I have seen here eight feet high, and the extracted fibre six feet long. So much attention indeed is given to length of stock amongst the Kakooos of the Chinese Frontier, that the gardens are walled in (with wattling) like a *Pan* (Piper Betle) garden.

"From the roots thus dressed up in February a crop will be cut in April, another in June, another in August, and another early in November, the most luxuriant crop being those of June and August, as naturally receiving the greatest quantity of moisture. The fifth crop takes from early in November to February, to come to maturity. Between the cuttings all that seems necessary is a fresh opening up of the ground around the roots, which in a regular plantation is best done by hoeing between the rows with a spade-shaped *hoe* set in a long handle; the person, as he performs this, going backwards, so as not to step over his work, — in fact, nothing can be more simple than the cultivation of this plant, all that is required being a loose rich soil, and protection to the crop, by a good strong fence. The roots throw up at least 12 shoots when in full bearing; should they increase, and the crops get too thick, the roots require to be separated: and by this means of planting out fresh ground and new plants from seed, the cultivation can be carried to any extent. It may be as well to mention also in comparison with the *Chu Mah* * that the roots produce a crop of stalks the first year, and that a *proso* † one acre, would probably produce about 6 maunds of fibre in the twelve months. ‡ But the next stage, that of cutting and removing the

* I can only give my Chinese authority here for noticing that "*Chu Mah*" is the name of this hemp or flax at a particular stage, that is "uncleaned" flax or hemp, but of course I cannot vouch for the truth of this.

† Major Hannay mentions in a subsequent communication, that he has greatly under-rated the quantity of *Rhass* produced on an acre of land. What it may be under every possible advantage of cultivation he is at a loss to say, but he thinks it likely to be more than double the quantity stated above.—Ed., Agri.-Hort. Soc.

B. 576-606.

fibres from the stalks, is the most difficult and expensive, and is practiced by the *Dooms* as follows:—

10. — *Cutting and Removing the Fibre from the Stalks.*—

The stalks are considered fit for cutting when they have become of a brown colour, for about six inches above the roots. To cut them the *Doom* seizes the leaves at the upper end with his left hand, and passing the right hand down to the root, strips off the leaves and cuts the stalk close to the ground. The stalks are made up into bundles, and the scraping off the outer bark commences at the same time, or this operation is deferred until the whole crop of the plot has been cut. The scraping off of the fibre from each stalk is a very tedious operation, and is performed with a blunt-edged knife; all that is left is the fibre and the woody part of the stalk, which are exposed to a hot sun for two or three days to dry. The third morning, after having been exposed to the dew for several hours, the fibre is drawn off. This is done by breaking the woody stalk right through, towards the thicker end, and then separating the fibre therefrom; drawing it off slowly, toward the small end, some care being required in giving the same a peculiar twist, so as to draw off as much as possible: having finished with the smaller end, what remains on the thick end of the stalk is pulled off in the same manner. It will be seen that this is a very clumsy way of extracting the fibre, and, as far as I can judge, $\frac{1}{4}$ th of the fibre still remains on the stalk, which may be taken off, however, at a second breaking; but the *Dooms* are not particular so long as they get what they require.

The hanks of fibre are then separately twisted at the upper end, and tied up in bundles of long hanks of about one seer in weight, if to be kept for sale: as the fibre, however, thus extracted, is quite ready for the purpose of net making, little or nothing more is done, than to open out and prepare the threads for spinning, which is done first by drawing the single hanks several times with a blunt-edged slip of bamboo held in the right hand, this softens and strengthens the fibres, and they are more easily opened out to the required fineness with the fingers and thumb nails, and then made up into small hanks ready for the spinning process; the first stage of which is performed by the women, with the common *takra* or spindle, in general use throughout India, the hanks having been well opened out and spread over the top of a high circular open bamboo frame, set end-ways on the ground. The further operation of spinning these first threads to the requisite thickness and the weaving of the nets is performed by the men."

The qualities of the *Rhee*, however, deserve much more attention than is given to it by the *Dooms*: a steeping of the fibre for the night in a decoction of the *Arum* plant, with a subsequent washing in clean river

REVIEW
OF
EARLY
OPINIONS.

Yield of Fibre
per Acre.

Conf. with
paras. 71,
72, 73, 74,
75, 76, 77,
78, 79, 80.

Nature of
Stalks.

Leaves
Stripped.

Bark Scraped
off.

Ribbons not
Formed.

Conf. with
paras. 81,
82, 83, 84.

Canes at once
Scraped.

Fibre Dried.

Conf. with
paras. 79,
80, 81.

Fibre
Removed
from Stems.

After
Treatment
of Fibre.

Conf. with
paras. 81,
82, 83.

Spinning.

Steeping
in a
Starchy
Fluid.

Conf. with
para. 78.

**BOEHMERIA
niven.****Colonel Hannay's Description of Chinese Method.****ASSAM.**

**Polishing
or Silvering
the Fibre.**

**Use of
Add Water.
Conf. with
paras. 81,
82.**

**Dyeing the
Fibre.**

**Yield per
Acre.**

**Conf. with
paras. 34,
71, 72, 80,
83, 84, 85,
87, 88, 89-
100.**

Price.

**Conf. with
paras. 2, 4,
43, 65, 71,
81, 83, 84,
103, 106,
140.**

**Encourage-
ment
by
Premiums
on
Production.**

**Cost of
Production.**

**Conf. with
paras. 34,
71, 85, 87.**

**Cheaper
Prepara-
tion.**

**Conf. with
paras. 87-
88.**

**Land
Available
in Assam.**

water, improves the colour and softens the fibre very much, added to which a slight hatcheling on the blunt-edged bamboo, or drawing the single hanks with a piece of coarse cloth held firmly in the right hand, brings it quite in a state of preparation for the English patent hatchling machine. In the state of yarn it is easily affected also by the acidulated water of the fruit of the *Garcinia pedunculata*, and thus prepared is taking colour more readily, and when dyed black it has great glossiness and would, I think, answer well for all kinds of common braiding."

81. Dalton's Scheme of a Premium.—In a letter addressed to Colonel F. Jenkins, Revenue Commissioner of Assam, Captain E. T. Dalton, then Collector of Lakhimpur, on the 1st March 1851, advised despatch of a consignment of fibre that had been prepared by Major Hannay from a field of:—

"Rather more than three *bighas*, or just about an acre of this plot is planted with *rheea*, which last season gave seven Indian *mans* of fibre."

Captain Dalton then says, "At present the cultivation is restricted to a particular class, the *Dooms* or fishermen, and the only use made of the fibre is in the manufacture by them of nets. For this purpose the fibre sells in the bazar at as much as eight annas the seer. The price is high only because the quantity raised and required has hitherto been so small." "To offer a premium would be better than to have an experimental Government farm, for there is no mystery in the process of rearing the plant, and the premium would stimulate the ryots equally with the speculator."

In reply to this letter Colonel Jenkins wrote that by—

"The method of preparation adopted by the Chinese and myself, costs at least Rs per maund, you will see that it can scarcely be sent to Calcutta at the price offered:* however, it is to be hoped that some cheaper method of preparation from the stalk may yet be adopted, in which case, considering the advantages of such quantities of available land in Upper Assam, I venture to say the *Rheea* would under-sell all other flax in the home market."

We are still on the outlook for a cheaper method of preparing the fibre than hand labour, but meantime tea has expanded to such an extent that it may be said that it is highly doubtful if suitable land is so very plentiful now-a-days as in Colonel Jenkins' time.

82. A Chinese Method of Cleaning Fibre in Assam.—In a letter which appears in the proceedings of the Agri-Horti. Soc. of

* £20 a ton.—G. Watt.

Mr. Mann on Rhea in Assam. (G. Mann.)

BOEHMERIA
niven.

India (Vol. X) for the 11th August 1858, Colonel S. F. Hannay returns to the subject and furnishes particulars of a new method of removing the fibres in the form of ribbons which he calls the Chinese method. As the passage is of historic interest it may be given here :—

— The stalks of the *Rheas* are cut to within 3 inches of the ground and each being broken in the middle by a particular method, by passing the fingers towards each end and through the fibre, this is stripped off, the outer bark and all; the stalks are left on the ground, and the strips made up into bundles, are placed in water for about a couple of hours; this steeping extracts a quantity of brownish-coloured matter, which would discolour, if not injure, the fibre if allowed to remain.

— The bundles are then tied at the small ends, and hooked on to a post; each strand is taken separately in the left hand, and with a blunt blade in the right hand they are cleverly deprived of their outer bark; one draw of the knife, along the inner side, taking away the pulpy matter which remains there, thus leaving a clean strand of fibre only, which, hung up inside to dry in wet weather, or exposed to a little sun and a night's dew in dry weather, is fit for the English market. In scraping off the bark, a small quantity of long and short fibre goes with it. When the work is finished, take up the whole of this entangled refuse, put it in clean water for a short time, dry and beat it out, and the result is the tow I now send; and thus every particle of the fibre on each stalk is saved. The tow subjected to bleaching would, I think, be found useful in many ways, for instance, to be made up into hospital lint, or for paper.

— The above method of preparing the *Rheas* is different from that pursued by the Assamese *Dooms*, and which I have already detailed in a former notice of the *Rheas* fibre. But a cheaper method of preparation, and one which is best suited for preparation on the large scale, is to subject the strips of fibre, after being taken from the stalks, to the steaming process in boxes, tubes or cylinders. The steaming will soon carry off the sap and its bad qualities, and the bundles well dried will then, I think, be quite in a marketable state."

83. *Other Opinions.*—Mr. G. Mann, then Assistant Conservator of Forests, wrote an interesting letter on the 4th July 1870, certain passages from which may be here usefully recorded :—

— I have not seen this plant growing wild in Assam, and the Natives state that it is not met with wild. "The cultivation of the plant is generally carried on on small patches of cleared, well prepared, and heavily manured land, near the huts of the *Dooms* or fishermen." It is propagated

REVIEW
of
EARLY
OPINIONS.Preparation
of
Ribbons.
Conf. with
paras. 12,
22, 76, 80.Steeping
in Water.
Conf. with
paras. 29,
34, 72, 100,
102.Scraping
Bark from
Ribbons.Waste.
Conf. with
para. 80.

Bleaching.

Doom
Method.Steaming
Process.
Conf. with
paras. 86,
121.Mr. Mann's
Report.Is not Wild.
Conf. with
paras. 6-7,
41, 42, 46,
52, 60, 77.

**BHEMERIA
niver.****Rhea versus Tea.****ASIAN.****Heavy
Manuring
Essential.****Seedling
Doubtful.**
Conf. with
paras. 17,
22, 21, 79,
124.**Yield.**Conf. with
paras. 24,
71, 72-80,
81, 82, 87,
96, 99-100.**Shade
Injurious.****Price.**Conf. with
paras. 3, 4,
9, 21, 84.**Ban Rhea.
Cultivation
Necessary.**Conf. with
paras. 43,
46, 55,
62-63, 70.**Cultivation.
Fays.**Conf. with
para. 96.**Native
Production
Doubtful.****Outturn
per Acre.**Conf. with
paras. 71,
72-80, 81,
82, 85, 96,
99-100.**Price.**Conf. with
paras. 3, 4,
6, 24, 64, 71,
103, 124,
136, 140.**Cost of
Production.**Conf. with
paras. 34,
71, 81, 87.

by division of the root stocks and not by seed. The Natives state that it bears seed, which, I think, however, is doubtful." "The quantity and quality of the fibre increases and improves the more care is bestowed on the preparation of the ground." "If well cultivated, three to four crops may be obtained during the season; the plant will reach a height of four to five feet. If grown in the shade of a tree it produces less and of an inferior quality than in the open. If the ground on which the plant is grown gets inundated, the plants die." "The fibre is grown chiefly for home use, not for exportation. Sometimes, if sold amongst the fishermen it fetches from 12 annas to Rs 2-8-0 per seer."

"The wild or 'Ban Rhea' of Assam is a species of *Urena*, a common tropical weed of the order of *Malvaceae* and not related to the true rhea." "For the above reasons I am of opinion that the rhea plant cannot be freely produced in Assam in a 'wild' or semi-wild state with scarcely any cultivation, since the vegetation of this Province is so luxuriant and dense that the rhea plant is not at all likely to become master over it. Any care bestowed on the cultivation of rhea does well repay itself, and the Province is exceedingly well suited to its cultivation; but like many other products, to make it remunerative, it requires industry and energy, both traits almost unknown to the present scanty population of Assam."

84. Some years later Mr. Mann wrote a report on the Cultivation of the Rhea Plant in Assam (see reprint in *Dictionary of Economic Products, Vol. VI., Part 1., pp. 464-65*). The following passages may be taken from that report so as to more fully exhibit Mr. Mann's views:—

"The outturn per acre, according to the statements of the *Dhimis*, or fishermen, in the different districts where I made inquiries, is only from 200 to 300lb of clean fibre an acre per annum; but their statements are very unreliable."

"The main question at issue is, whether the Rhea plant can be cultivated sufficiently cheaply in this province so as to allow the fibre to be used to a greater extent in the manufacture of cheap articles, produced in large quantity, so that it may become a great staple and develop into a large trade, as is pointed out by Dr. Watson, in paragraph 45 of his report. If its extensive introduction into the home markets depends on its being supplied at an average price of £30 to £40 per ton of rough fibre, as stated by Dr. Watson, in paragraph 46 of his report, this province will not be a source of supply, since it cannot be produced here at even double that rate at present, or in future either as far as can be judged now, for its production requires as much time and labour as tea does."

B. 575-606.

Nowgong Experiment. (G. Wall.)

BOEHMERIA
nives.

whilst the latter plant produces on an average 250 lb per acre, and fetches on an average one shilling and eight pence per pound in Calcutta.*

- In fact, at the above low value of Rhea fibre, as quoted by Dr. Watson, it would only give a return about equal to rice, whilst its cultivation requires double and treble the time and attention. For this reason, I do not even see a likelihood of its being grown in the Sylhet district, where there is a greater population, and labour is comparatively cheap."

"From the above remarks it will be seen that Rhea fibre has no chance in this province since the success of the tea cultivation will, as far as can be judged at present, always prevent European capital being employed on Rhea cultivation, and it is far too laborious for natives of this province to take to, as they have done in Bengal to jute cultivation, for the sake of gain, as long as the fibre has to be produced at £40 per ton."

85. While Rhea cultivation is referred to in many official publications, subsequent to the above Selections from the Records of the Government of India, very little information of a definite nature has been brought to light regarding the yield of fibre per acre. The following passage from the Agricultural Report of Assam for the year 1885-86 will, however, be read with interest. It confirms in general terms the reports published by the jails regarding their experiments in Rhea cultivation.

The following passage from the Report of the Agricultural Department of Assam for 1885-86 is here given as it records the results obtained during an experimental cultivation at Nowgong :—

"A small quantity of Rhea was grown in the Nowgong Jail during the year under report. The object of the experiment was double. Details as to the cost of producing the fibre were required, and a comparison between the crop as grown in shade and as grown in the sun, was wanted. The second object was quickly gained. The plants put down in the shade refused to grow at all and were a total failure. The patch grown in the sun, on the other hand, did well. An area 71' x 74' (= 1 k. 3 a.) was planted in the jail garden in the middle of April."

"The first cutting yielded 3 seers of dried fibre in July. The second cutting yielded 10 seers 9 chittacks in September. The third cutting yielded 7 seers 4 chittacks in October. Total yield in six months = 20 seers 13 chittacks = value (at R1 per seer) R20-13.

"The total cost of planting, cutting, and extracting the fibre was R13; consequently, on an expenditure of R13 there was in six months a profit

REVIEW
OF
EARLY
OPINIONS.
Twice or
Three Times
as Trouble-
some as
Rice.

Rhea Fibre
has no
chance in
Assam.
Conf. with
para. 82.

Tea will
always be
Preferred.
Conf. with
para. 101,
100.

Yield per
Acre.

Nowgong
Experiment.
Conf. with
para. 89
and 100.

Plants
Grown under
Shade were
a Failure.

First
Cutting.

* This unfortunately could hardly be given as the average price obtained for tea at the present day.—G. Wall.

BOEHMERIA NIVES.

Mr. Bruce's Report.

ASSAY.	of R7-13. When I saw the crop in the middle of December it was nearly fit to cut, and might safely have been estimated to yield one more crop before the following April. Therefore, five crops might be calculated as from the above data in one period of twelve months. But the produce from three crops was 20 seers 13 chittacks; therefore the produce from five crops would be 34 seers 11 chittacks. (I have allowed for slower growth in the cold weather by only taking one crop between December and April.) But the cost of cutting and extracting fibre from one crop was R2. Therefore, the cost of the two additional crops would be R4. Therefore the total expenditure in twelve months would be R17. Therefore the net profit in twelve months would be R17-11, or, roughly, 100 per cent. per annum. Working out the figures for the acre we see that the weight of fibre obtainable would be 911 lb and the cost R222 per annum.
Five Cuttings. <i>Conf. with paras. 70, 75, 84, 86.</i>	
Profit.	
Mr. Bruce's Opinions and Experience.	86. Mr. H. W. Bruce, a practical tea planter, wrote to the Deputy Commissioner of Darang a letter (2nd July 1870) much to the same effect as Mr. Mann's first letter. The following passages may be taken from Mr. Bruce's communication:—
Must be well Manured. <i>Conf. with paras. 76, 81, 86.</i>	"Whatever be the quality of the soil, it has to be well manured and cowdung. After the ground has been cleared, it should be well deep-hoed. A quantity of manure should then be scattered all over the land after which it should be well ploughed over several times, so as to thoroughly mix the manure with the soil. It must be prepared in January or February, not later."
Method of Planting.	"Immediately the ground is ready, rhea roots must be procured and planted in the drains about nine inches to a foot apart. The roots should be completely covered with earth. In April the rhea will have grown to about two to three feet in height, and is then ready to be cut; but as it generally throws out branches and grows crooked in its first growth, it is cut close to the ground, and all the cut stalks, branches, leaves, etc., are allowed to lie and rot in the ground to enrich the soil. In the course of a month about eight or ten straight stalks grow up from each root to the height of about four feet, and are ready for the second cutting. They are cut down close to the ground, and grow up again in the course of another month to be cut a third time."
Green Manuring. <i>Conf. with paras. 70, 100.</i>	"In the first year of sowing, after the fourth cutting, it does not grow long enough to be of any use. In November more manure is put to the roots and after each cutting the ground is weeded."
Cuttings and Yield. <i>Conf. with paras. 71, 86, 88-100.</i>	"In the second and third years the rhea is cut six times, that is, if the soil is good and well manured, not otherwise. After the fourth year, as the growth becomes less vigorous, the roots should be taken up and sown elsewhere."
More Manure.	
Six Cuttings.	
Transplanted in Fourth Year.	

China Grass.

(G. Wall.)

SCHEMERIA
nivea.

"After the rhea is cut, the outer bark or skin should be scraped off. This should be done on the day the rhea is cut, if possible, but not later than the second day, as the bark dries, and is not so easily taken off as on the first day when it is quite in a green state. The Assamese take the bark off with a flat piece of bamboo, about six inches in length and an inch broad, with rather sharp edges. One man can generally scrape about 300 stalks in the course of the day. After the outer bark is taken off, the stalks are put in the sun to dry. When thoroughly dried, the fibre is peeled off."

"The fibre after being well washed and combed is dried, and is then ready for use. By some it is combed so fine that it has the appearance of silk."

By The Cost of Cultivation.—"In my opinion I do not think that any profit can be made on rhea cultivation until a machine is made that will take off the outer bark and extract the fibre. The expense in cultivation alone is small in comparison with the cost of taking off the bark and fibre."

"From my experience in cultivating a small piece of a cottah, I think the expense on one poorah would be as follows:—

Price of labour, Rs and Rs per mensem; clearing, hoeing, ploughing, manuring, and sowing, for the first year	Rs 30
Weeding throughout the rains, and manuring again in November or December	25
Cutting rhea, taking off bark, and extracting the fibre, four times for the first year	200
Cost of weeding and manuring for the second year	25
Cutting, taking off bark, and extracting fibre, six times for the second year	230
Same expense for the third year	255
Same expense for the fourth year	255
Total expense for four years	Rs 1,040

"The probable yield from one poorah would be about ten maunds which amount, even if it realized Rs 500 (at Rs 50 per maund), would show a loss of about Rs 500 at the end of four years."

"For the first year the yield is about four seers per cottah, or two maunds from poorah. This is what I have found it to be from my own experience; but as I only tried it for one year, I cannot say what the output would be on better soil."

"From what I have been informed by the Natives who nearly all cultivate small patches of rhea for their own use, the yield in the second year is about one-half more than in the first year; and in the third and fourth years it is about the same as in the second year."

REVIEW
of
EAST
AFRICANA.

Scraping the
Stems.

Conf. with
para. 72,
73.

The Scraper.

A Day's Work
Stalks are
Dried.

Conf. with
para. 72,
73.

Cost of
Cultivation
Small.

Conf. with
para. 34,
71, 81, 84,
85.

No Profit can
be got
without
Machinery.

Cost of
Production.

Conf. with
para. 3, 5,
34, 43, 45,
71, 85, 103,
140, 150.

Probable
Yield.

Conf. with
para. 75-80,
81, 82, 84,
85, 86,
88-100.

Possible Loss.

BEHMERIA
sivea.

Mr. Monahan's Note.

ASSAM.
Two Visits
to Assam.Goalpara.
Conf. with
para. 25,
24, 26, 27.Imperfect
Knowledge
Regarding
the Assam
Rhea.Conf. with
para. 17.The Assam
Bulletin of
Agriculture
No. 1, Rhea.Buchanan-
Hamilton's
Collections
from
Goalpara.
Conf. with
para. 22.

PERSONAL EXPLORATIONS IN ASSAM.

88. I visited Assam on two occasions; *first*, from March to July 1895, in connection with investigations into the Pests and Diseases of the Tea Plant; and *second*, during February and March 1897, in connection with the present enquiry. On both occasions I devoted considerable attention to the study of Rhea, and made numerous collections of specimens in every district except Goalpara which I was unable to visit. On my arrival at Gauhati on the 26th February 1897, I had the pleasure to meet Mr. Monahan, Director of Land Records and Agriculture, and we consulted together on the subject of Rhea. At his request I showed him most of the collections I had made up to date, explained fully the confusion that had arisen as to the Assam plant having been wrongly supposed to be the variety *tenacissima* and as to its being by some writers spoken of as indigenous to the valley. Mr. Monahan was good enough to agree to co-operate with me and undertook to supervise the work of one of my plant collectors, during a tour of inspection through the district of Kamrup. Mr. Monahan has, however, anticipated this report somewhat by publishing the results of his enquiries in Bulletin No. 1 of the Agricultural Department of Assam. In consequence that paper may be said to be the first Indian publication that has definitely corrected the errors I have above indicated. But since the views set forth by Mr. Monahan so nearly coincide with my own, I do not think it necessary to specialise the villages visited by me, nor to furnish a separate chapter descriptive of the methods of cultivation and manufacture that I found pursued. I shall, therefore, take the liberty to republish a considerable portion of Mr. Monahan's *Note*. But I shall omit all references to provinces other than Assam and details that have been rendered unnecessary, though the treatment of the same subjects in the foregoing pages. Where it may seem desirable I shall also add further particulars to some of the sections of Mr. Monahan's *Note*, when my diary appears to contain additional or later particulars. The result may, therefore, be accepted as a combined report on the Rhea of Assam, and I trust Mr. Monahan may discover no occasion to take exception to my treatment of his useful report.

89. *Vernacular Names*.—"Rhea (*Rihs*) is the vernacular name by which *Behmeria sivea* is known in the four upper districts of the valley,—Lakhimpur, Sibsagar, Darrang, and Nowgong. In some parts

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(G. Watt.) **BOEHMERIA**
nivea.

of the Kamrup district it is known as rhea, and, in others, by the Bengali name, *Kankhura*. Mr. Monahan then adds, "In the Surma Valley (Sylhet and Cachar districts), no form of rhea is known to the native cultivators."

It will be seen that, according to a letter in the Journal, Agri-Horticultural Society, Captain Jenkins first made acquaintance with it in Cachar.

9a. *Area under Rhea.*—"There are no accurate statistics of the area under rhea in Assam. The crop is found, here and there, throughout the five districts of Kamrup, Nowgong, Darrang, Sibsagar, and Lakhimpur, and is raised by cultivators of all classes; not by the fishing caste only, as has been stated. In spite of this wide distribution, the total area under rhea is unimportant. In the districts named, its cultivation is confined to a small proportion of the total number of villages, and in any one village, as a rule, not more than half a dozen *raiya*ts will be found who cultivate it, while the average area cultivated by each *raiya* is, as already stated, extremely small.

"In the whole of the Assam Valley, the total area under rhea probably does not exceed 2,000 acres. The small extent of rhea cultivation in Assam is easily understood, when the labour involved in preparing the fibre is taken into account, and when it is considered that the Assamese manufacture from it fishing nets and lines only, and are unacquainted with the higher uses to which it can be put."

9t. *Soil and Manure.*—"The soil on which rhea (*Boehmeria nivea*) is cultivated should be light and free, not stiff, and either naturally rich, or well manured. It must also be above the reach of inundation, and well drained, as the plant is at once killed by water lodging at its roots. Subject to these conditions, it would appear that rhea can be grown in Assam on a variety of different soils. In the Assam Valley, the rich loam which composes good tea land has been found suitable for it, and in Sylhet it is reported to be grown most successfully on well-drained *bhal* land. By the Assamese, however, it is most usually raised on sandy loam, which has been artificially fertilised, chiefly with cow-dung manure."

Mr. Monahan adds a further circumstance of interest.—"The more careful cultivators, if the ground is not already well drained, and quite secure from inundation, commence operations by digging a trench about two feet deep round the patch selected. The ground must be well leached."

In several villages I was told that in addition to cowdung they also manured with dry grass and rice husk, mixed with earth obtained

SCIENTIFIC
OPINIONS.

Jenkins
Discovered
it in Cachar.
Conf. with
para. 89.
Fishermen
Cultivators.
Conf. with
paras. 87,
89, 90, 91.

Area under
Rhea.

Suitable Soil.
Conf. with
para. 88,
89, 90, 91,
92.

Sandy Loam.

Method of
Cultivation.
Conf. with
para. 88,
89, 90,
91, 92.

Manure.
Conf. with
para. 89,
90, 91.

BCHMERIA
Rives.

Mr Monahan's Note.

Ashes.	from other fields ; the husk was also very often given in the contents of ashes. Mr. Monahan alludes to this subject in the following :—
Wood Ashes. Conf. with para. 100.	“ Wood ashes from the cooking hearth are sometimes thrown on the ground, where rhea is grown, but they are not regularly used as manure. Some cultivators mention the use of rice husks as manure for rhea, while others state that the husks are spread on the ground for the purpose of attracting field mice, which render assistance by nibbling, and so reducing the size of the rhea roots, when the excessive growth of the latter results in overcrowding, and the consequent deterioration of the stems. This statement the writer has not had an opportunity of verifying.”
Field Mice.	During my investigations I nowhere came across a cultivator who mentioned any service rendered by field mice. The habit of using rice husked or ashes I found to prevail more especially at Jorhat. Near Gauhati I visited several villages where the rhea plantations were interspersed with castor-oil trees, or such trees formed a hedge around the plots. I enquired the reason and was told that the castor-oil leaves greatly enrich the soil, so that the two plants flourished in association.
Rice Husk.	92. <i>Propagation</i> .—“ The crop is generally grown from root cuttings, though in some places stem cuttings are occasionally used, and, according to the statements of Native cultivators, can be planted at any time during the rainy season (April to October); but the months usually selected for planting are <i>Baisakh</i> (15th April to 15th May) and <i>Kartik</i> (15th October to 15th November).”
Castor Oil Associated with Rhea.	In a great many villages inspected by me in Sibsagar district I was assured the best season for transplanting was in the middle of February. The cuttings were said to be made 6 to 9 inches in length and were planted under 3 to 4 inches of soil and 1½ feet apart each way. In one instance the cultivator said it was preferable to transplant in January by which means the first cutting could be made in May and allow of five cuttings in the year.
Method and Seasons of Propagation Conf. with para. 86, 89.	93. <i>Climatic Conditions Favourable</i> .—Mr. Monahan goes into details on a point of great importance in favour of Assam which accounts for the plant furnishing a crop of shoots late into the cold season, much beyond the period mentioned above for Bengal. Mr. Monahan writes :—
Favourable for Rhea. Conf. with para. 86.	“ At Saharanpur, and in all other parts of Northern India, except Assam, little rain occurs during the months of the cold weather (November to March), and the early part of the hot season, comprised in the B. 576-606.

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SCHEMERIA
nives.

months of April and May, and the first half of June, is characterised by intense, dry heat. In Assam there are no dry, hot months, the rains setting in regularly by the middle of April, and even during the cold weather humidity is greater than in other parts of Northern India. Accordingly, in Assam, rhea continues growing throughout the year, though at a somewhat slower rate in the cold weather than in the rains; and whereas, at Saharapur, the crop is cut only twice a year, once in June, and once in October or November, in Assam cuttings are obtained at much more frequent intervals, as will be shown further on. According to the statements of numerous cultivators who have been examined, there is no difference, as regards the quality or their fibre, or the difficulty of separating it, between rhea stems cut in the cold weather and those obtained in the rains. The writer has seen, in March, at the end of an unusually dry cold weather, in Lower Assam, stems over six feet high, and apparently uniform of rhea plants which, he was assured, had been cut only two months before. The rapidity of growth, however, especially during the cold weather, depends much on the amount of manure applied, and the general care taken in the cultivation. The stems just referred to were grown on carefully tended land, while, at the same time, and on land of probably the same natural fertility, the rhea crop observed was withered and stunted and not likely to yield any fibre till the beginning of the rains."

94. I venture to think that this circumstance is one of vital importance in rhea cultivation. In fact I have little doubt that in the future any expansion of production westward, within the submontane tract already indicated (*para. 66*) will bear a direct relation to the extent of cold season humidity.

95. *Period of Duration on Fields.*—"Proverbially careless and untidy, the Assamese *raiya* is little disposed to take trouble with a crop like rhea, the produce of which is required by him only in small quantities for domestic consumption. It is hence somewhat difficult to estimate from Assam experience what the crop is capable of under careful cultivation. In the majority of instances, except a little weeding during the first few months of growth, nothing is done for the rhea patch after planting, and its owner looks only to cutting the stems as often as they become fit for use. Under this treatment, after two years, the soil becomes exhausted, and the rhea stems grow weak and thin; the roots are then taken up, divided, and replanted elsewhere. The more intelligent *raiya*s, however, admit that, with frequent manuring, rhea can be continuously grown on the same land for many years; indeed they place no limit on the length of time for which the crop can be cultivated on the same land if only manure enough be applied. There is room for doubt as to what the

RECENT
OPINIONS.No Dry Hot
Months.Growth
during Cold
Weather.Expansion
of Area of
Production.Conf. with
paras. 17,
50, 51, 52,
53.Transplant-
ing.Soil
Exhaustion.
Conf. with
paras. 53,
151.

**BURMESE
RHEA.**

Mr. Monahan's Note.

ASSAM.Number of
Years
Cultivated.
Conf. with
p. 96.Close
Planting
Advocated.Cultivated on
High Beds of
Manure.Seasons.
Conf. with
p. 96, 97.

maximum period is. In reports from China and America, very long periods, varying from 30 to 100 years, have been mentioned; but it seems probable that unless some process of thinning were resorted to, transplanting at comparatively short intervals would be necessitated by the overcrowding of the roots. In paragraph 8 of Mr. Montgomery's report on the experimental cultivation of rhea in Kangra (Dictionary of Economic Products, Volume VI., Part I., page 472) the removal of the roots every four years is recommended, in order to avoid overcrowding. On the other hand, in the report of the Superintendent of the Botanical Gardens, Saharanpur, quoted at pages 476-481 of the same volume, close planting is advocated, with a view to preventing the growth of weeds and improving the quality of the fibre. By the Assamese the crowding of the roots, as well as the impoverishment of the soil, is sometimes alleged as a reason for replanting the crop on fresh land, but the writer has seen it flourishing on land where it is said to have been grown continuously for eight years without thinning."

The majority of the cultivators questioned by me in Assam affirmed that there was not much occasion to transplant the roots; they might be grown at all events on the same field for 20 years. But I would add that most of the old plots were some 12 to 18 inches in height above the level of the rest of the homestead enclosures, and I was told this was due to the annual addition of a thick coating of cowdung. And that statement seemed fully substantiated by the appearance of the plot of land which looked more like a cucumber bed than a field.

96. *Cuttings*.—On this subject Mr. Monahan writes:—

"In different published descriptions of rhea cultivation, in which the number of cuttings that can be obtained in a year is referred to, it appears to be implied that, at certain intervals, the whole of the stems from roots planted at the same time in a field can be cut simultaneously. This, however, is not the usual practice in Assam, where the received opinion is that, in order to obtain the greatest outturn and best quality of fibre, each stem must be cut at a certain stage of its growth, namely, when the lower portion of the stem turns brown, and before the plant has flowered. As all the stems from roots planted together do not reach this stage simultaneously, the custom is to cut selected stems from time to time as they become fit for use. In this way selected stems are cut at intervals of from one to two months in the rainy season, and from two to three months in the cold weather. Rhea planted at the end of the rainy season (October to November) will yield the first cutting about the end of March or begin-

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ing of April: If planting be carried out at the beginning of April, the first cutting may be obtained about the middle of May. When the crop has fairly established itself, cuttings may be taken regularly at the intervals mentioned above."

Most of my informants spoke of four or five cuttings a year, as, for example, in May, June, July, August and November or even December, depending on the nature of the season. But one old and experienced cultivator at a village in Sibsagar district, with whom Mr. Severin, of Sanari, and myself had a conversation, told us that he could make his field yield a cutting every 15 to 20 days. His contention was that yield was entirely a question of manure and moisture, and I presume he was not far from correct. He argued that the quality of the fibre depended upon the rapidity of growth, the older the stems the coarser the fibre, and hence in his opinion it was not only true that high manuring paid, but when moisture was deficient it would also pay to irrigate. A sudden interruption to growth of shoots he held ruined the fibre.

97. *Irrigation and Weeding.*—But on the question of irrigation Mr. Monahan writes:—"No irrigation is required for rhea in Assam. Between the time of planting and the first cutting, constant and careful weeding is necessary, but, after that, light hoeing between the rows after each cutting, and manuring once a year, if the soil be poor, seems to be all the cultivation that the crop requires."

98. *Preparation of Fibre.*—Mr. Monahan says:—"The method of preparing the fibre in Assam has been described in reports previously published, and may be briefly recapitulated here. After the stems have been cut, the leaves are stripped off, and the green outer cuticle removed by scraping with a knife. The stems are then dried in the sun for from four to six days, after which the bark is peeled off, and left to steep for two or three hours in cold water, in which pieces of some acid fruit are sometimes placed along with it. The acid appears to have the effect of dissolving the gum contained in the bark, and facilitating its removal. After this steeping, the fibre is separated by washing the bark in clean water and rubbing it between the hands."

Every one of the cultivators questioned by me said it was most important that scraping off the green pulpy bark should be done at once. If delayed, the fibre, they said, would become hard and much more difficult to clean. I presume that by the expression "after which the bark is peeled off" in Mr. Monahan's paragraph just quoted, he means the layer of fibres left adhering to the stem. Practically the

RECENT
OPINIONS.

Number of
Cuttings.
Conf. with
paras. 70,
71, 72-80,
81, 82, 83,
84, 85, 100.

Quality of
Fibre.

Weeding.
Conf. with
paras. 80.

Preparation
of Fibre.
Conf. with
paras. 81,
82, 72, 80,
83.

Use of Acid.
Conf. with
paras. 80,
81, 100.

Scraping
the Shoots.
Conf. with
paras. 70,
71, 80.

BEHMERIA
niven.

Mr. Monahan's Note.

ASSAM.
The Gum.**Garcinia**
Fruits.
Conf. with
para. 86.
*100.***Yield per**
Acres.
Conf. with
para. 71,
78-80, 81,
83, 84, 85,
90, 100, 111,
117, 121,
123, 127,
131, 135-6,
138, 158,
171, 176-80.
Kangra
Returns.
Conf. with
*para. 138.***Mr.**
Kershaw's
Estimate.
Conf. with
para. 100.

whole of the bark is scraped off in the green state and with it by far the major portion of the gum. The fibre on being dried still no doubt contains a considerable amount of gum and the steeping in acid fluids, it may be recollected, is part of the treatment recommended by most of the patent processes for cleaning. Colonel Hannay has alluded to the use of *Garcinia pedunculata* which, if not exactly containing acid (in the chemical sense spoken of in the patent processes for cleaning) is at least highly astringent. It seems desirable that the exact action of these natural or rather vegetable acids should be chemically investigated. It is quite likely that some of them would serve the purpose of softening and removing the gum without entailing the risk of injury to the fibre.

99. Outturn.—On this subject Mr. Monahan writes:—"It is necessarily very difficult to estimate, from the statements of Native cultivators, the average outturn of cleaned fibre which may be obtained from a given area of land under rhea, which is properly cultivated. As mentioned above, careful cultivation of this crop is the exception, and the peasant who raises it, as a rule, on a diminutive patch, not exceeding three or four perches in extent, keeps no strict account of the fibre which it affords, a few handfuls at a time, for domestic uses. The Assamese peasant is, moreover, strongly averse to giving any information about the outturn of his crops, and any statements he makes on the subject are usually under-estimates. Calculations based on such statements, which may be taken for what they are worth, give estimates of outturn for rhea varying from 76lb to 605lb of cleaned fibre per acre. On the other hand, the estimate deduced from an experiment made in the Nowgong district jail* in 1885 was 911lb per acre. Mr. Buckingham estimates the outturn under favourable circumstances, at 640lb per acre, and this may probably be taken as a safe estimate for Assam. Mr. Montgomery after twelve years' experience of rhea cultivation in Kangra, estimated the outturn of cleaned and dried fibre at 972lb per acre."

The average of all the statements of yield made to me by the Assam cultivators approximates very closely to 8 maunds (640lb) of clean fibre to the acre. One very intelligent cultivator assured me, however, that a plot of land which I measured (15 yards by 30 yards) had for many years past yielded him one maund of clean fibre a year, which he was able to dispose of at Rs.8-0 a seer, that is to say, it produced 10.75 maunds, or a return of Rs.1,000 an acre.

* See para. 85, also Mr. Kershaw's remarks, para. 100.

Mr. Kershaw's Experiments.

(G. Watt.)

BOEHMERIA
nivea.

This is very nearly the figure quoted by Mr. Montgomery (*ibid.* 137) and is less than that given by Colonel Hannay (*para.* 79).

100. But in this place it will be instructive if I furnish a report of an actual crop experiment made by Mr. L. J. Kershaw, Assistant Deputy Commissioner, Golaghat—

• Crop experiment Rhea (*Boehmeria nivea*).

• First cutting (May 7th, 1897).

• The only record I can find of a rhea crop experiment made in Assam is of one conducted in the Nowgong jail in 1885. The cropped area was in that case almost exactly $\frac{1}{4}$ th acre and the outturn reduced to lb per acre was—

First cutting, July	•	•	•	•	•	48
Second " September	•	•	•	•	•	169
Third " October	•	•	•	•	•	110

TOTAL . . . 333 lb per acre.

• The present experiment refers to the first and least productive cutting of the season.

• The area of the plot selected was 430 square feet or as nearly as possible $\frac{1}{10}$ of an acre. This is the ordinary size of a plot of rhea grown by the *raiyats* in this district. The plant was cultivated on a cushion of rich sandy soil, liberally treated with cowdung *phutai* (wood ash), charcoal and rubbish. The mature plants averaged 3' 6" in height. The stalks were first cut at about 2" from the ground. The leaves were then stripped. These leaves were afterwards used as manure. The outer bark was then scraped off with a sharpened bamboo, the stems tightly rubbed with a cloth and carefully put aside. If the stems at this stage get wet or dirty the fibre is said to rot. This operation occupied 12 persons from 2 to 2½ hours. The stems were then taken to my bungalow and placed in the sun each day until thoroughly dried and bleached almost white. This occupied four days. The fibre was then stripped from the stems. This occupied four men a day. As the method of extracting the fibre from the dried stems appears to be in some respects different from that described in the Director of Land Records' Note on Rhea (Assam Agri. Bulletin No. 3) I describe the process in some detail. The stem (but not the fibre) is first broken a few inches from the top. The operator holding in each hand the wood near the break, with a sharp motion something between a thrust and a twist, disengages the fibre from about an inch of the wood, which breaks into small pieces and falls. The fibre is then disengaged from the shorter piece of wood which is thrown away. The ends of the fibre are then carefully gathered together, care being taken that no strands escape. Holding the ends of the

RECENT
OPINIONS.Actual Crop
Experiment.Nowgong
Experiment.

Cuttings.

Highly
Manured.Successor
Bark
Scraped off.Exposed
Fibre Rubbed
with a Cloth.Fibre Dried.
Coaf. with
suns. 75
75, 80, 80.Operation of
Separating
Fibre.

BOENNERIA
nivea.**Yield of Stems.****ANAL.**Fibre Steeped
in Water.
Conf. with
gurus. 22,
23, 72, 23.

fibre in one hand and the stick in the other, a strong pull is given and a long tress of clean fibre is extracted. This operation is repeated low down the stem so as to take up any strands which may have escaped the first pull. The uncleaned fibre is then steeped in water, no acid tract is put in the water by *raiya*s in this neighbourhood. The bundles of fibre are while still wet beaten violently against a flat board after the manner of a *dhobi* beating clothes. The fibre is then dried in the sun.

"The cleaned fibre is spun into reha cord with a small *takuri*, and twisted into reha cord with a large *takuri*.

"During the cutting a sample batch of plants, weighing 2½ seers, was divided into stalks of different length and scraped with the following results:—

Weight of
Leaves.

Total weight.	Length of stem.	No.	Weight after stripping leaves.	Weight after scraping bark.
	3'	13	Total.	Total.
	2½'	25	32	23
	2'	26	31	21
Total.	12'	19	18	15
300			6	3½
			87	6½
			113	bark 1½
			TOTALS	300

"From the whole plot 1,396 stalks were cut. These were divided into lengths, weighed when wet, after the bark was scraped off, and weighed when dried. The results obtained were—

Weight of
Fibre and
Stems.
Conf. with
gurus. 123.

No. of stalks.	Average length.	Weight total (when wet after being scraped).	Weight after being dried in the sun 4 days.	Un-leaned fibre.	Cleaned fibre.
		Total.	Total.	Total.	
347	3' 1"	700	170	30	---
388	2' 6"	430	80	16	---
431	2' 0"	280	---	---	47½
230	1' 3"	100	60	13	---
		1,510	310	55	47½
		Moisture	1,200	wood 255	7½
		TOTALS	1,510	310	55

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Mr. Kershaw's Experiments.

(G. Wall.)

BEHMERIA
niven.

* Combining these two results and reducing the figures to lb per acre, it appears that the total weight of the crop of an acre (stalks and leaves) would be 11,185lb made up as follows:—

	lb
Leaves	6,320
Bark	1,090
Moisture	3,000
Cleaned fibre	118½
Dirt and bark lost in washing the uncleaned fibre	18½
Sticks	637
TOTAL	11,185

First Cutting:
Yield per
Acre.
Conf. with
pares. 26,
21, 70-80,
22, 24, 27,
20, 26,

* The net result of the experiment is that the first cutting gives 118½lb per acre or about 2½ times as much as obtained in the Nowgong experiment.

* The following table shows the amount of uncleaned fibre extracted from:—

		Percentage of fibre to wet stems.	Percentage of uncleaned fibre to dried stems.	Percentage of clean fibre to wet stems.	Percentage of clean fibre to dried stems.
Stems averaging .	3' 2"	3'7	15'3		
	2' 6"	3'7	20'0		
Short stem .	1' 2"	3'7	21'6		
TOTAL .	—	3'6	17'7	3'1	15'3

Percentages
of Fibre.

* The plot on which the experiment was made was not regarded as good. I could indeed class it as under the average. The shoots averaged only 3 to 4 feet in height, but possibly this is an advantage as it would appear that the shorter the stalk the greater the percentage of fibre extracted.

Height of
Crop.
Conf. with
pares. 70,
70, 22, 26,
27, 100, 100
122, 122, 100

* I hope to be able to ascertain the yield of the 2nd and 3rd cuttings of the same plot. If the yield continues to be three times as great as that obtained in the Nowgong experiment, the total yield would appear to be over 900lb per acre. Any estimate, however, is useless until experiments of the yield of the 2nd and 3rd cuttings are made.

Total Yield
900lb.

* R. 172-213.

**BOHMERIA
nivea.****Prospects of Rhea in Assam.****BURMA.**

"The owner of the plot experimented on gave me last year's yield. These figures must naturally be accepted with some caution. Reduced to Rs per acre they are—

1st cutting	.	.	.	.	.	.	.	Rs
2nd "	.	.	.	.	.	.	.	150
3rd "	.	.	.	.	.	.	.	225
	.	.	.	.	.	.	.	225
TOTAL	.	.	.	.	.	.	.	600

101. *Prospects of Rhea in Assam.*—The concluding pages of Mr. Monahan's *Notes* are devoted to this subject, but as most of the points have been already abundantly discussed in the foregoing pages, I do not consider it necessary to furnish the entire passage. Speaking of the information derived from Native cultivators, he says:—

"It is certain that, on this point, no conclusion can be safely drawn from existing cultivation in the province, which is everywhere of the nature of garden cultivation." He then goes on to say the climate, as already shown, is exceptionally favourable "while waste land suitable for the crop is available in abundance."

"On the other hand, there is no probability that the cultivation of rhea will ever be undertaken on a large scale by the Assamese *raiya*, owing to the labour involved in the separation of the fibre by hand, and to the fact that any machinery or process by which it could be more easily extracted would be beyond the *raiya*'s means. The present condition of the Assamese peasant is such that he is not compelled to engage in any laborious occupation in order to obtain a subsistence, which is all that he requires, and even the trouble of preparing jute for the market has been sufficient hitherto to deter him from the cultivation of that crop, in spite of the large profits which it would probably yield him. So far as present indications go, it appears that, if rhea cultivation is ever to become an important industry in Assam, it must be established there, like the tea industry, by European capital, with the help of imported labour. Before investing capital in this speculation, it would be well if parallel experiments could be made with *Bohmeria nivea* and *Bohmeria tenacissima*, in order to decide which variety thrives best in the Assam climate.

CULTIVATION IN BURMA.

102. *History.*—I have already mentioned that the discoverer of Rhea in Burma was Colonel Burney. In a letter to Mr. J. Kyd, dated 6th December 1835, he gives us many interesting particulars which subsequent investigators have practically only confirmed. I make no hesitation, therefore, in republishing Colonel Burney's letter

Garden
Cultivation.
Conf. with
para. 7, 35,
39, 47, 49,
53, 101.

Jute.
Conf. with
para. 8, 39,
40, 54, 100.

European
Capital.
Conf. with
para. 100.

BURMA.

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Colonel Burney's Report.

(G. Wall.)

BOMMERIA
nivea.

so as to make this report on the rhea-growing districts of India as complete as possible. I have not had the pleasure of visiting the Shan States, and therefore have no additional particulars to offer except that, through the kindness of the Inspector General of Forests, I have been furnished with an admirable series of specimens. The plant proves to be *Bommeria nivea*, and not the variety *tenacissima*. Colonel Burney writes:—

"I send you a small specimen of a kind of *Hemp* which is brought here from the Shan Provinces of Pivela and Youkzouk, lying six or eight days' journey to the south-east of Ava. This material appears to others as well as to myself of superior quality, and I should like to hear your opinion of it. My inquiries from the Shans inform me, that they regularly cultivate the plant which produces this hemp; that it has a bulb-bearing root from which they propagate it; that the stem grows 5 to 6 feet high, and about the thickness of a man's fore-finger; that they cut it down to the ground once a year, and it grows up again from the same root as often as they cut it; and that this hemp forms a kind of rind or coat over the stem, and may be taken off after macerating the stem in water, or not—the former process, however, making the hemp much whiter in colour, although depriving it of some of its strength and toughness, after rubbing or scraping off the cuticle of the bark, the stem is beat all round, and this hemp peeled off. The Shans use this material in manufacturing every kind of cordage, and weaving a stout kind of cloth, of which they make bags. They call it *Pan*, and the Burmese, who know it only as coming, like almost every other good thing in this country, from the Shan Provinces, call it *Gown*. I have engaged some Shans to go to Pivela and bring me some of the stems, and a supply of bulbs and, if you think the material as good as I do and worth your attention, I will send you some of the bulbs and some to our Tennasserim Provinces, where, I think, the plant could be easily very extensively cultivated. The Shans put the bulbs into the ground in the beginning of the rains in March or April, and declare that the stems are long enough to be cut in September or October. The specimen I send you was gathered, some say, too soon, before the stem had attained its full growth. The Burmese have the common hemp plant, and call it *paik-lo han*."

103. *Experimental Cultivation*.—Two years later (1837) Captain H. Macfarquhar sent a sample of the fibre grown in his garden at Tavoy from plants furnished by Colonel Burney. Still later (1843)

The "*Urtica tenacissima*"—for a description of which vide Dr. Roxburgh's *Observations on Substitutes for Hemp and Flax*, page 69.—*Ed. Agri-Hort. Soc. Jour.*

HISTORY.

Discovered
in 1834.Burney's
Account of
Discovery.Not with in
the Shan
Country.Steeping in
Water.Conf. with
paras. 30,
34, 35, 36,
100.Bark
Scraped off.Woven into
Cloth.Conf. with
paras. 16,
34, 77, 80d.Planted out
at the begin-
ning of the
Rains.Conf. with
paras. 30,
34, 35, 36.Cultivated
at Tavoy.

**SCHEMNERIA
nivea.****Rhea (Riha) or****BURMA.**

Price of
Clean Fibre.
Conf. with
paras. 2-4,
5, 45, 65,
81, 82, 84,
124-6, 130,
140.

Mr. Cop-
eland's Report

Reported
Exports to
China.

Price of
Fibre.

Bark
Scraped off.
Conf. with
paras. 72,
76, 78, 80,
82, 86, 88.

Mr. Carr's
Communi-
cations.

Mr. A. H. Landers contributed to the Agri-Horticultural Society of India a paper on "The Vegetable Products of the Shan Country," in which he makes mention of this plant. Mason (*Burma and its People*) gives a brief account of the cultivation of the plant, but in Theobald's Edition (*Vol. II., 265*) the remarks offered might be said to read like the prospectus of some company owning a patent process. There is hardly a sentence in the passage that can be regarded as having any reference to Burma or in fact to India. The statement is made that the ribbons of bark, stripped off in a particular way, would fetch from £60 to £120 a ton in England.

104. *Recent Investigations.*—The Inspector General of Forests has obligingly placed in my hands copies of letters that have passed between himself and the officers of his Department, in Burma. Some of these contain useful additional information, though it must be confessed the subject has as yet been far from satisfactorily investigated. I may give the following as specially interesting:—Mr. J. Copeland, Deputy Conservator of Forests, Mandalay Division, records in his diary the following note:—

"Saturday 22nd, marched to Nanlan about 10 miles. This is the place where it was reported that the rhea was cultivated on a large scale, quantities of it being exported to China. Small plots of the plant are found attached to several houses in all the villages on this plateau, but it is only cultivated for domestic use and not for sale, as a general rule, though small quantities of it are sometimes procurable in the Nanlan Bazar where it fetches as much as 8 annas a viss.* It is propagated from root cuttings which take readily in the rains, and not much care requires to be taken of the plants. It grows to a height of 4 feet and over. The fibre is separated by hand, the stalk being previously scraped with a *da* to clean it. It is used for making into a sort of rough twine. The *thugyi* says that if there was any sale for it, the people would be glad to extend its cultivation. Nanlan is only 30 miles from Thibaw, and will be within 20 miles of the branch railway to Kyatsi Mansam, so it is worth while to encourage the Shans to extend its cultivation."

105. It will also be instructive to furnish here two letters by Mr. Carr, Officiating Deputy Conservator of Forests, Mandalay Division (dated 25th August and 13th October 1896). His reference to the so-called "wild rhea" of Burma is interesting since it has been from similar remarks regarding Assam that the idea of *B. nivea* being indigenous have doubtless proceeded.

* 1 viss = 3.68 lb. Av.

Recent Investigations in Burma.

(G. Watt.)

BOEHMERIA
nivea.

"In reply to your No. 618-34—A-3, dated the 10th June 1896, I have the honour to state that a species *Boehmeria* which from a comparison with the plants sent up from Rangoon I take to be *B. nivea*, is already cultivated on the Shan Plateau. There was a field of *gun* (by which name the plant is known there) in the old village of Maymyo, but one of the tree roads which is being constructed cut right through it, and all the plants were destroyed. I found only one or two shoots left, and they would scarcely do as botanical specimens.

SHAN
STATES.

"I was informed that the plant was introduced from China, and is cultivated in several places in the Shan States especially by the Palungs. The bags in which the latter carry their betel boxes and other odds and ends are made from the fibre. It is cultivated from cuttings which take easily. I may mention that the plants sent from Rangoon and put down in the Forest bungalow compound at Maymyo have all taken root and promise to do well.

Introduced
from China.

"I have not been able to obtain any confirmation of the report that in Manig Kanig the fibre is pressed into bales and sent across the Salween to China. There is a trade with China in fibre of some sort, but it is not known yet whether it is rhea. The Forester at Maymyo has been instructed to proceed to Nannan and bring specimens of the fibre and the plant producing it. Mr. Johnson, of the Bombay, Burma Trading Corporation, Limited, who recently visited Yatsank, a neighbouring State, says that when he asked for *gun* he was shown the cotton, and that the people were ignorant of any fibre-producing plants except the *Shawz*."

Trade to
China not
Confirmed.Name *gun*
sometimes
given to
Cotton.

"With reference to your letter No. 1217-34—A-2, dated the 26th August 1896, I have the honour to submit the following additional information regarding rhea. The *gun* species is almost certainly *Boehmeria nivea*, but another species called by the Burmans *Hpetye** is found wild in the neighbourhood of Maymyo and, I am informed, all over the Southern Shan States. The *Hpetye* is a stinging species. The fibre is not considered to be as good as that of *gun* and is not used much by the Burmans. The Palungs, however, are said to mix it with *gun* and use the two together although they prefer *gun*. *Hpetye* is said to be fairly plentiful, while considerable difficulty has been experienced in getting *gun* fibre, only about 4 or 5 lb having been obtained up to date.

A Wild Rhea.

Is not
Plentiful.

"*Gun* fibre is used by the Palungs for making their small bags, but except for this its principal local use is for sewing leather sandals. The makers of these sandals pay Rs. 4-0 per viss for the fibre. At this rate a ton would cost approximately £45 sterling bought locally, and as the

Uses of Rhea.

* The plant here mentioned was forwarded to me and proved to be *Gracilaria heterophylla* and consequently was not Rhea.—G. Watt.

BEHMERIA river.

Rhea employed in Sewing Sandals.

BURMA.

Price of Fibre.

Conf. with
parcs. 5, 6,
8, 24, 42, 52,
71, 82, 84,
102, 104,
124-126,
128, 140.

Manufac- tures.

Conf. with
parcs. 14,
53, 72, 102,
204.

Linschoten's
Herbe
Bengalen
Written,
1600.

Shawle and
Saria.

Conf. with
parcs. 16,
77.

Bhagalpur
Admixture
with Silk.
Conf. with
parcs. 52.

Rhea Fibre Treatment Company only offer £7-10-0 per ton, delivered in Rangoon, it seems unnecessary to discuss the question of carriage.

"As rhea fibre is light and bulky, freight would probably be at a high rate and to obtain it locally at £6 per ton is equivalent to 6 ^{ris} for 8₁ or at two-fifteenths of the present rate. Of course with an extended scale of cultivation and machinery the cost of production might be considerably lessened, but it scarcely seems possible that it can ever be profitably worked in Burma at a selling rate of £7-10-0 per ton, delivered in Rangoon.

Botanical Specimens.—"I forward herewith botanical specimens of both *gun* and *hptyi* as well as some fibre of the latter species. Owing to defective preserving arrangements and damage during transport to Mandalay the specimens are very poor."

106. *Manufactures.*—Mr. Carr's allusion to the use of rhea fibre woven into small bags recalls Colonel Burney's description as also the very similar bags which on the Assam Frontier are invariably made from the *Ban-riha* fibre (*Villebrunea integrifolia*) and never from rhea. So also the Jabaka and even Angami Nagas employ the fibre of *Girardinea heterophylla* mixed with *Ban-riha*, cotton or other textiles. But if there be no mistake as to the fibre being employed by the Shan tribes this is the only mention of rhea being woven into fabrics in India.

107. Mr. Carr's allusion to the makers of leather sandals employing the fibre for sewing thread, brings to mind Linschoten's very curious description of the "Herbe Bengalen" which, he tells us, was employed for sewing quilts. A modern use of rhea is the preparation of shoe-makers' thread, a purpose for which its great strength very highly recommends it. Linschoten says:—

"They do most cunningly stitch their coverlits, pavilions, pillows, carpets, and mantles." "Likewise they make whole pieces or webbs of this herbe sometimes mixed and woven with silk, although those ~~the~~ hearbe itself are dearer and more esteemed, and is much sayer then the silk. These webbs are named Sarrijn, and is much used and worn in India, as well for men's breeches as dublets, and it may be washed like linen, (and being washed) it sheweth and continueth as faire as if it were new."

I have already alluded to the report that the people of Bhagalpur formerly mixed, and, perhaps, to this day still mix, rhea with silk. That fact and the above reference to the textile use of the fibre in Burma, are the only instances that I have been able to discover of
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China Grass.	(G. Wall.)	BOHMERIA nivea.
<p>the fibre being put to any other purpose than that of making-fishing lines and nets. Linnehoten's remarks, though they seem to apply more directly to rhea than to any other fibre, are open to the criticism that it is difficult to see how a fibre once so extensively employed and so highly valued, could have come to be disused. But whatever the fibre was, it is not now employed in the way he describes, so that it is just possible it was rhea, and that a more extensive knowledge in this fibre and wilder cultivation prevailed formerly than at the present day.</p>		BURMA.
<p>CULTIVATION IN MADRAS AND MYSORE.</p>		MADRAS.
<p>108. Although in South India there would appear to be no Native industry in growing this plant, it has been experimented with on a large scale by several European gentlemen and companies. In fact it might also be said that the possibilities of the crop have been more fully tested in South India than in any other part of this country.</p>		<p>Probable Decline in Use during Modern Times.</p>
<p>109. The Agri-Horticultural Society of Madras has for many years taken an active part in forwarding the enquiry, and at the Government Experimental Farm of Saidapet, the plant has been repeatedly cultivated though only to a small extent. But the object of this report, being mainly to afford information regarding the crop in the districts where it is regularly grown by the Native cultivators I can at most indicate the chief sources of my information and the final results that have been obtained in Madras.</p>		
<p>110. <i>Glenrock Company's Experiment.</i>—One of the oldest and, perhaps, the most important experiment of this nature was that undertaken by the Glenrock Company, Ltd. Mr. Samuel Jennings has given (<i>Agri-Horticultural Society of India, Vol. VII. (n. s.), pp. 307-323</i>), a full account of the Company's efforts which will be found highly instructive and should be consulted. Mr. J. W. Minchin was in 1884 brought out from England to manage the Glenrock Company's contemplated Rhea Plantations, and on the way to this country he paid a visit to Algiers in order to see the method pursued by the great French Pioneers in this industry. Mr. Minchin has been good enough to favour me with some of the practical results obtained and the opinions he formed of the experiment, during his connection with the Company. It will, perhaps, be unnecessary for me to quote the correspondence in full form, but I have Mr. Minchin's authority to make any use I please of the particulars supplied, and</p>		<p>Extensively Experimented with.</p>
		<p>Mr. Minchin's Report.</p>
<p>R. 172-213.</p>		

BOEHMERIA
sives.

Mr. Minchin's Report.

RADRAS.	shall therefore give the more important points which he has made out:—												
Average Cultivated.	<p>"I was employed, he writes, by the Glenrock Company, Ltd., to cultivate and treat rhea on their property at Pandalur in South-East Wynaad. The Glenrock Company also undertook the cultivation of rhea at Kullar in the Bhowany Valley, about 5 miles from Mettappolium. Some 400 acres of rhea were planted in the forests on the slopes of the ghats below Pandalur village and about 100 acres at Kullar.</p>												
Irrigation Essential.	<p>111. <i>Yield of Stems.</i>—"The growth of the rhea was all that could be desired; as many as six cuttings of stems were obtained in the year, where assistance could be given to the plants by irrigation. Without irrigation at Pandalur three cuttings were obtained between the months of June and November, during which months the rainfall is about 100 inches in all. The best outturn from one measured acre in 1886-87 under irrigation during the dry months was six cuttings:—</p>												
Best Outturn. Conf. with pages 84, 71, 79-80, 81, 83, 84, 85, 87, 89, 94, 99-100, 127, 127.	<table> <tr> <td>1,384 lb of stems (8 stems to the lb.)</td><td>about 11,000 stems.</td></tr> <tr> <td>2,028 lb " (ditto)</td><td>" 16,000 "</td></tr> <tr> <td>4,446 lb " (5 ditto)</td><td>" 22,000 "</td></tr> <tr> <td>4,904 lb " (6½ ditto)</td><td>" 30,000 "</td></tr> <tr> <td>3,660 lb " (9½ ditto)</td><td>" 25,000 "</td></tr> <tr> <td>1,605 lb " (15 ditto)</td><td>" 24,000 "</td></tr> </table> <p>18,027 lb (8 tons) weight of stems in the year about 128,000 stems.</p>	1,384 lb of stems (8 stems to the lb.)	about 11,000 stems.	2,028 lb " (ditto)	" 16,000 "	4,446 lb " (5 ditto)	" 22,000 "	4,904 lb " (6½ ditto)	" 30,000 "	3,660 lb " (9½ ditto)	" 25,000 "	1,605 lb " (15 ditto)	" 24,000 "
1,384 lb of stems (8 stems to the lb.)	about 11,000 stems.												
2,028 lb " (ditto)	" 16,000 "												
4,446 lb " (5 ditto)	" 22,000 "												
4,904 lb " (6½ ditto)	" 30,000 "												
3,660 lb " (9½ ditto)	" 25,000 "												
1,605 lb " (15 ditto)	" 24,000 "												
Steaming Process. Conf. with pages 84, 85.	<p>112. <i>Machinery Employed.</i>—"This was an exceptionally fine field with facilities for water. The stems were treated in Deane and Woodward's Machines, but a considerable loss of ribbon was sustained. Also by the Fremy system of steaming and removing the cuticle by hand. Small portable boilers on wheels were used, which followed the coolies who were cutting the stems along roads through the cultivation. The steam was turned into closed wooden boxes into which the stems were placed. The skinning by hand was a slow process, but the ribbon was saved.</p>												
Drying Ribbons. Conf. with pages 13, 83, 75, 80, 89, 103, 111.	<p>113. <i>Drying Ribbons.</i>—"There was, however, great difficulty in drying the ribbons during the rains in the Wynaad when alone the stems grow except under irrigation. Drying rooms were made with hot air pipes and exhaust pans for drawing off the moisture.</p>												
Did not Pay.	<p>114. <i>Period of Experiment.</i>—"The cultivation and experiments were continued by the Glenrock Company from the beginning of 1884 until 1889, say five years, but the fibre obtained at the price named, did not pay for the cost of production, and accordingly the cultivation was given up.</p>												

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Results obtained at Glenrock.

(G. Watt.)

BEHMERIA
nivea.

115. *Plants Available.*—The rhea planted in the Glenrock Company's Forests is still there contending with the jungle growth although it has been deserted for the last six years, and any amount of roots and plants can be obtained from that Company for future experiments."

In reply to a communication in which I asked for certain additional information, Mr. Minchin was good enough to reply as follows:—

116. *Climatic Conditions of Wynaad.*—"I think the soil and climate of the Wynaad were very suitable to the cultivation of rhea. Three good cuttings were obtained without irrigation during the rains. There is always very little rain for four or five months of the year. It may be that a more equable distribution of the rain might give a fourth cutting.

117. *Outturn Exaggerated.*—"Every facility was provided by the Glenrock Company for the treatment of the rhea and every opportunity for the cleaning and disposal of the filasse at the full price available. I consider that the figures on which the production and outturn of rhea have hitherto been based are very greatly exaggerated. Calculations have for the most part been made on a quite insufficient basis."

118. "Mr. Montgomery, of Kangra Valley, bases his calculations on the returns from 1,000 stems which were all over 6 feet long and weighed over a pound each. On this he gives 1,000lb of ribbons as his yearly crop.

"Some writers make their calculations on the produce of a square metre of land: others on the produce of a square yard of land; still others on the number of stems from one plant.

"But the outturn of ribbon from weight or number of stems treated, depends on the condition of the stems, how long cut, their age and condition when cut.

119. *Proportion of Water.*—"Dr. Forbes Watson in his Report on Rhea in 1875, calculates that the proportion of water in the green stems varies from 75 per cent. to 80 per cent. I found during the heavy rains that the proportion of water was as much as 90 per cent. of the weight of green stem.

120. "The only statement that I have seen of the quantity of stems actually obtained from any considerable area is that in Colonel Hyde's report on Greig's machine in 1872 when 7,360lb of stems was cut from 1½ acres of ground in the Saharanpur Gardens. But even that acreage was not accurately ascertained. Colonel Hyde assumes the crop to be 2 tons of stems per cutting per acre.

121. *Variations in Yield.*—"Even with irrigation the different cuttings will not be alike. The outturn of ribbons to the weight of green stems treated also varies very greatly. Mr. Montgomery calculated this at

FIVE YEARS
EXPERI-
MENTS.Survival of
Stock.Conf. with
para. 18,
52, 53, 54,
55.Irrigation.
Conf. with
para. 56,
57, 110, 127.Conflicting
Returns.Conf. with
para. 71,
86, 123, 131,
133.Montgo-
mery's Calcu-
lations.Conf. with
para. 133.Varying
Factors.Conf. with
para. 131.Colonel
Hyde's Calcu-
lations.Conf. with
para. 170.Age at which
Cut.

BEHMERIA
nivea.

Mr. Mischke's Report.

MADRAS.

Steam Decortication.

Conf. with
paras. 84,
85.Percentage
of Ribbons.Percentage
of Water.Conf. with
para. 126.Dr. Watson's
Estimate.Conf. with
para. 121.500lb Filasse
per Acre.

Price.

Conf. with
para. 126.Capital
Required.Conf. with
para. 101.A Large
Contract.

Price.

Conf. with
paras. 2-4,
9, 43, 65,
71, 81, 83,
103-5, 114,
126, 140,
154.

6½ per cent. from large stems and 3½ per cent. from small stems. Stems will not all grow to the same size. They must be cut when they begin to brown at the base whatever their size. Colonel Hyde from Greig's machine got 2½ per cent. ribbons. In Algiers and the South of France, Mr. Fowler states that 10 per cent. of ribbons is obtained from the green stems by the Fremy steam decortication process. These are much dryer climates than the Wynaad—there is probably a much smaller proportion of water in the green stems. The Glenrock Company obtained only about 3½ per cent. ribbons by the Deeth and Ellwood machine and from 5 per cent. to 6 per cent. ribbons by steam decortication, according to the season of the year.

122. *Replanting.*—"Rhea is a most exhausting crop and will require periodical replanting and heavy expenditure in manure to keep it up.

123. *Yield.*—"I consider that Dr. Watson's estimate of 750lb of ribbons per acre the utmost that can be obtained per annum from rhea and that quantity only under very high cultivation. These 750lb ribbons should give after degumming about 500lb of clean filasse which I think is worth now one shilling per lb* if it could be supplied in quantity.

124. *Price too Low.*—"Unless the market is prepared to give up to £70 per ton for rhea ribbons, I do not think there is any inducement to undertake the cultivation.

125. *Spinning and Weaving.*—"The long-staple rhea fibre will not be used except with machinery especially adapted for it, and the new machinery will not be erected until a large and regular supply can be obtained. A large expenditure of capital in the cultivation will be necessary before a market for the filasse can be assured, and the manufacturers must give a very long price for the raw material when available. I was informed by a large manufacturer that if I could supply 50 tons of the filasse per month, he would contract to buy it at eight annas per pound† in India. But it would require an area under cultivation of 3 to 4,000 acres to ensure a yield of 50 tons a month.

126. *Comparative Cost of Jute and Rhea.*—"The price we talked of £7 per ton for ribbons will obtain no supply (see para. 144). Jute, as Dr. Watson reports, gives 1,500lb of fibre per acre in one cutting and is worth from £12 to £20 per ton. Rhea will give half this amount in several cuttings and with very much greater cost in cutting, treatment and cultivation.

"I consider that the future of rhea depends on the price that it may be worth."

* Mr. Minchin's letter was dated 12th August 1896.

† This might be said to be the average price at which the clean fibre can be procured in North Bengal and Assam, viz. Rs 1 a seer.—G. H. S.

The Reading Rhea Fibre Estate.

(G. Wall.)

BEHMERIA
nivea.

127. *The Reading Rhea Fibre Estate.*—Another experiment at rhea cultivation on a fairly extensive scale was undertaken in South India, namely, by Messrs. James Finlay & Co. at their Reading Estate. This was started in 1887 and discontinued in 1894. It was under the management of Mr. W. Rhodes James. I am unfortunately not in a position to afford full particulars regarding this experiment, but I understand that the highest yield from one acre in one cutting, was 64 cwt. 3 qrs. of green stems. The average yield came to 1,300 lb green ribbons per acre per crop, on what was called the bed system of cultivation. On the open system an acre yielded 2nd crop 2,056 lb and 3rd crop 2,685 lb green ribbons.

"It was, I understand, found that dry ribbons ran to about 20 per cent. of the weight of green ribbons, and dry ribbons ran about 7 per cent. of the weight of green stems.

"Irrigation and manuring were found indispensable."

128. *Mysore.*—Mr. John Cameron has recently published a *Memorandum on the Rhea-fibre Plant* which no doubt incorporates experience gained at the Mysore Government Botanic Gardens. The following passages may be here taken from Mr. Cameron's report:—

"*Propagation.*—To secure seed, the plants cultivated in this country require very special treatment. But even then the supply is usually scanty and precarious. It is fortunate, therefore, that the rhea plant is so readily propagated by the division of its tubers, offsets and stems. The best plan is to lift a matured plant bodily for the purpose of division. The tubers, which resemble small potatoes, can then be dibbled into the nursery separately, the larger ones possessing several 'eyes' can also be cut into 'sets' as in the esculent just referred to. Then by careful handling, a sturdy root-stock can be separated into many parts, each having a little root and stem. Finally, the cane or stem can be reduced into cuttings of 5-6 inches in length. The best cuttings are obtained from the matured wood, but treated under glass, in fine sand, the tender or herbaceous portions of the stem will also take root. By the above methods many thousands of plants can be raised from even a limited stock. But to ensure success it should be done during the growing season. In this climate, old stools and freshly rooted slips are practically as hardy as nettles, so that once established the plant is propagated without risk or even much trouble. The botanic gardens possess several thousand plants from which young stock can be raised in quantity. Rhea has also been domesticated to some extent in the coffee districts, so that, even in the absence of seed, we have ample material to propagate from."

129. "*Sites for Natural Growth.*—In Mysore, the hill country included in the districts of Hassan, Kadur, and Shimoga, affords the position

SEVEN
YEARS
EXPERI-
MENTS.Highest Yield
Conf. with
para. 111.Percentage of
Ribbons.Irrigation,
Conf. with
paras. 97,
110, 116.Production of
Seed.
Conf. with
paras. 17,
22, 31, 79,
82.Propagation
by Root
Cuttings.
Conf. with
paras. 29,
32, 79, 83,
86, 92, 102,
104.Domesticated
in the Coffee
Districts.

**SCHEMERIA
nives.**

Mr. Cameron's Report.

**NTSONA.
Best Climate.**

and climate best suited to the hardy growth of rhea, and in the most favourable situations it is not improbable but the plant would run wild to some extent. What is really required in this new product is its possession in great quantity raised at a nominal cost."

**Available
Land.**

130. "*Sites for Cultivation.*—It follows that where the plant will thrive without help it will also be the most productive under liberal cultivation. Extensive areas of comparatively open forest land having a good head-flow of water from some perennial stream would answer well, providing that the soil is fertile and open. Good drainage is a very essential condition of this culture, so that the sloping sides of hills and *sholas* might be preferable to lands situated on flats and in basins. The annual rainfall should not be less than 50 inches and would not hurt growth if it reached 100. Wet lands on the sides of rivers and canals bordering the Mairnad would only be suitable if they are porous and easily drained. But in all probability the existing wet crops are much more profitable than rhea is ever likely to become under similar conditions of cultivation.

**Humidity
Required.****Existing
Crops more
Profitable.**

Soils.
Conf. with
paras. 44,
49, 50, 52,
78, 81.

Ploughing.

131. "*Cultivation.*—Virgin forest soil, and good loam with a liberal admixture of sand, are equally suitable for the vigorous growth of rhea. But there must be no stagnation of water, hence it is necessary that plots demarcated for planting should be thoroughly opened by the plough. This is best done at the close of the monsoon when the surface herbage can be ploughed in and left to rot during the dry season. At the bursting of the south-west monsoon, another thorough ploughing will be needed to make the surface soil soft and workable. Rooted plants of rhea can then be put out in the field at 3-4 feet apart. The crop will not be a full one during the first year, but in the second, third and fourth years it will be full. Under good cultivation the young plants throw out many suckers or offsets, and after 12-15 months of continual growth the intervening spaces will be nearly full of stems of various sizes. After the fourth year the growth becomes stunted and the fibre deteriorates in length, texture and value. When this takes place the field has to be entirely broken up and a new one laid down. But should it be preferred to break up and resuscitate the original field, a large amount of manure would have to be applied in the first instance and at reasonable intervals subsequently. After the first planting, field operations consist of weeding, hoeing, and removing the manured stems."

Planting.**Transplant-
ing.**

Manure.
Conf. with
paras. 70,
79, 83, 86,
91, 95, 96,
100, 127.

**Weeding and
Hoeing.****Irrigation.****Number of
Cuttings.**

"With continual growth all the year round supported by irrigation during the dry months, an average yield will be three cuttings, but under exceptional circumstances even four cuttings may be obtained."

132. "*Possible Yield per Acre.*—The outturn of fibre per acre differs according to climate and situation. But the best average results

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Mr. Cameron's Report.

(G. Watt.)

BENNERIA
nivea.

under proper cultivation are not likely to exceed eight tons* of ribbon (stripped bark) per annum. At any rate a larger quantity than this should not be expected from Indian cultivation."

133. *Present Market Value.*—Bales of assorted ribbons are now purchased on contract by a home company at £10 per ton. But it is very doubtful if this price would be maintained in the open market. Any quotation of value at the present stage of the industry must therefore be more or less unreliable. But supposing the yield in India is only six tons per annum and the market value £5 per ton, an acre of Rhea would still be worth £30 to the cultivator."

134. *Future Experiments.*—It will hardly be necessary for me to furnish other opinions regarding rhea cultivation in South India. It will doubtless be freely admitted that the experience gained by the Glenrock Company, though unfortunate, must be of the greatest value as a record for future guidance. Mr. Minchin's opinions are completely substantiated by the figures furnished by him. The regret naturally occurs that the enterprising Indian Pioneer Company ever attempted the crop in the Wynaad. There would seem to be no doubt that to dispose fully of the question of India's possible participation in the world's future supply of this wonderful fibre, one or two commercial undertakings on the scale of the Glenrock experiment are essential within the region where the plant has for centuries very possibly been grown by the people of India. It will be time enough to think of experiments in other parts of India when it has been proved that North Bengal and Assam can produce the fibre at a profitable rate.

135. *Maximum Acreage Yield.*—There has been no experiment either in North Bengal or Assam that can for a moment be compared with the efforts over which Mr. Minchin presided. His experience, so far as India is concerned, must be regarded as the only one with which the public have been favoured, that can be accepted as affording definite indications for future guidance. But if the available information that has been reviewed in the foregoing pages, regarding Bengal and Assam, can be trusted, there would seem little doubt that the yield in these provinces is considerably higher than that obtained by Mr. Minchin. Colonel Hannay had a fairly large plot of land under the crop in Upper Assam, and his ultimate conclusion appears to have been that a yield of about 12 maunds of clean fibre to the

WYSORE.

Yield per
Acre.

Conf. with
para. 54,
51, 78-80,
81, 82, 84,
85, 87, 88,
89, 90-100,
111, 117,
122, 127,
128.

Minchin's

Maximum

Yield at

750lb. an

Acre.

Wynaad
unfavourable.

Rhea Region.

Conf. with
para. 88-
88.

Experiment
on a Large
Scale
Essential.

Yield.
Conf. with
para. 54,
51, 78-80,
81, 82, 84,
85, 87, 88,
89, 90-100,
111, 117,
121, 122,
127, 131,
132, 134.

* Surely Mr. Cameron means 8 maunds, see para. 99.—G. Watt.

BECHMERIA **divers.**

Conclusions Regarding South India.

MADRAS.

Price.
 Conf. with
 paras. 2, 4,
 9, 54, 55,
 62, 71, 81,
 88, 84, 103,
 104, 105,
 114, 124,
 126, 140.

Future
 Prospects,
 etc.

Mr. Montgo-
 mery's
 Arrival in
 India.

Early Dis-
 appointments

acre was not impossible. Several cultivators assured me when I questioned them on this point, that they obtained from 8 to 10 mounds an acre. Mr. Monahan, the Director of Land Records and Agriculture in Assam, hesitates, however, to accept a higher yield than 4 cwt of scraped and cleaned fibre.

136. *Filasse, not Ribbons, Produced.*—Throughout Assam and Bengal, (as I have in several places in the above review stated), the Natives produce filasse not ribbons. They sell that article at a price that averages from 6 annas to 2 rupees 8 annas a seer (= 12 lb). Mr. Minchin tells us of a merchant who was willing to contract for a large monthly supply of filasse at 8 annas a pound. It would then appear probable that cultivation on a large scale and with the modern facilities for cleaning the fibre, might undersell the present native price, in other words that a price of 8 annas a pound for filasse might be remunerative. Indeed it will be admitted generally that this statement is the most hopeful part of Mr. Minchin's otherwise very unfavourable report.

CULTIVATION IN PANJAB.

137. *History.*—There is hardly anything further to say regarding the rhea cultivation in this province than has appeared already in the *Dictionary of Economic Products*; namely, the various reports on Mr. Montgomery's experiments.

On the 12th November 1894 I paid a visit to the Ram Bagh plantation in Kangra, in order to inspect what remained of Mr. Montgomery's farm. I had the pleasure to meet his widow—a lady then over 80 years of age (and since deceased)—from whom I learned many interesting details of the great struggle made by Mr. Montgomery and the numerous disappointments he had had to endure. Mr. Montgomery came to India in 1862 in the same ship with Mr. (afterwards Sir Robert) Egerton, at that time Settlement Officer in Gurdaspur, while Mr. P. Egerton was Deputy Commissioner in Kangra. Mr. Montgomery was persuaded by Sir Robert to commence his rhea experiments in Kangra, and the two gentlemen accordingly made their way up the Indus together.

138. The firm Mr. Montgomery came out to represent failed shortly after his arrival in India and he was thus left single handed. After much trouble he succeeded in procuring from China a small supply of seed (most of which failed to germinate) and six live plants.

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Visit to the Ram Bagh, Kangra.

(G. Watt.)

BOEHMERIA
nivea.

at a cost of Rs 300. From these his plantation was ultimately stocked and large supplies were subsequently sent to the Saharanpur Botanic Gardens, to Assam, to Mr. Minohia in the Wynad, to Baroda, to the Deccan, and even to the Sultan of Johore.

His Excellency Lord Mayo paid a visit to the Ram Bagh three months before his death. Mrs. Montgomery could remember every detail of that inspection and the pleasure Lord Mayo took in studying the cultivation of the plant and witnessing the extraction of the fibre from the stems.

139. *Fibre Separated by Chinese Workmen.*—Fortunately for Mr. Montgomery there were Chinese workmen employed at the time at the Government Holta Tea Estate in Kangra. Some of these men were lent to him, and on their arrival at the Ram Bagh they expressed astonishment at seeing the *Chu Ma* plant which they at once recognised and named. They stripped the shoots of their leaves and, laying the canes flat on a board, proceeded to scrape off the green bark, all the while that clean water was being made to play along the board. It was through these Chinamen that Mr. Montgomery ultimately learned many details of cultivation and the manipulation of cleaning the fibre.

140. Samples of filasse sent from the Ram Bagh during its early years fetched as much as £120 a ton, and Mrs. Montgomery showed with pride a collection of yarn and fabrics that had been spun and woven from her late husband's hand-cleaned filasse (since purchased and deposited in the Economic and Art Museum, Calcutta). But in spite of every effort Mr. Montgomery failed to obtain a remunerative price for his fibre and the cultivation of the plant remained as it is to-day in an experimental stage.

141. Mrs. Montgomery after explaining these historic incidents of the Kangra experiment then conducted me over the plantation, which ever since her husband's death she had continued zealously to supervise. On the questions of transplantation and exhaustion of soil she said that formerly every now and again the plants were dug up, the old wood rejected, and the fresh shoots replanted on the same ground. Manure she could not afford to give, but the soil in Mrs. Montgomery's opinion was so fertile that there was hardly any occasion for manure. One field had not been taken up during the past sixteen years, and yet the shoots on it were fully five feet in height during my inspection

MR. MONTGOMERY'S
EXPERI-
MENTS.Chinamen
Recognised
the Plant.Demonstrated
Method of
Cleaning
Fibre.Water Used
in Cleaning.
Conf. with
paras. 39,
54, 75, 83,
100.Failure Due to
Price Paid
for Fibre.Conf. with
paras. 8-6,
9, 43, 65, 81,
82, 84, 100, *
150.Transplant-
ing and
Exhaustion.Not
Transplanted
for 16 Years.
Conf. with
paras. 85,
86.

BOEHMERIA
nives.

Ram Bagh, Kangra.

PANJAB.

Situation of
Ram Bagh.Long Ribbons
of Clean
Fibre.

Conf. with
pages 13,
62, 76, 89,
103, 111,
121, 132,
135.

Price of Fibre
Locally.Nothing Done
for 16 Years.Preparatory
Operations.

in November. Thus for over 30 years the Chinese plant has been grown on the Ram Bagh without showing either degeneration of stock or exhaustion of soil.

142. The Ram Bagh is a fertile bit of rich loam, situate down in the very bottom of the valley, and only a foot or two above the level of the river, but the various rhea plots are well shaded by avenues of fruit and other trees. Irrigation and even silt manure is available whenever required.

Subsequent to the date of my visit to Kangra I had the pleasure to receive several letters from Mrs. Montgomery, of which the following passages may be published in this place :—

"Shortly after you were here I had all cut down that you saw gone to seed, none of the stems were more than five and six feet long and very thin, from the best of them I had the fibre stript, it was very strong and good for rope and string, but not what I would send anywhere as a good specimen of long dry fibre."

"On the other parts where you saw the plant fresh and green the stems were short and went to seed, then unfortunately the *guddies* sheep and goats got on the ground and ate all the leaves and tops of the young stems. Though fresh ones have sprung up and are growing well, I do not think there will be any fit for the long ribbon-like fibre, such as was formerly prepared here by merely scraping off the gummy matter using only cold water and no chemicals of any kind. In this way a beautiful white fibre can be obtained without machinery at a trifling expense, and Kahars here gladly purchase it at Rs per seer."

"To produce long thick stems for good fibre, all the China-grass I have requires to be transplanted; roots or cuttings even, planted 2 feet apart, soon outgrow that space. It is more than 16 years since any of my plants have had anything done beyond being cut down and the fibre used merely for rope and string. If my land could be ploughed *at once*, the roots separated and replanted, there would be a good crop of long stems by the end of May, but this I cannot do. I am not inclined to meet the expense as I am far too old now to be able to see to the work being done properly."

143. "I should be glad to meet with a purchaser for my property which is freehold, it was purchased before Lord Canning's Act was repealed. Great expense had to be incurred to root up all the trees of milk bush, cactus, etc., and to line out and build retaining walls, to terraces and lay out water channels, before the China-grass could be planted. Cuttings and seed had to be obtained direct from China, but when planted the climate of Kangra and the locality of the Ram Bagh was found to be

B. 576-606.

Results Obtained in Kangra.

(G. Hall.)

BOEHMERIA
nivea.

admirably suited for the cultivation of the China-grass, stems of 70 and 12 feet in height growing rapidly and giving 3, 4, and sometimes 5 crops in a year."

"The plant is so readily propagated by division of roots and cuttings that almost any amount of land could be stocked, from a single plant. I have made 176 which at 2 feet apart outgrow that space in 2½ to 3 years."

"Some years ago I was requested by Mr. A. O. Hume to send a ton of dried stems. I had them cut, dried and sorted, so, sent all of an equal length, viz., 12 feet."

"I have a Bessler's patent fibre-cleaning machine here, but some years ago fibre prepared by it was valued at £40 per ton, while that cleaned by the Chinese method, was worth £120 the ton."

"I have made many experiments and found various methods of extracting the fibre cheaply which I would gladly show to any one wishing to purchase my property."

144. *Mr. Montgomery's Report.*—The following, being Mr. Montgomery's last report, may be given here since it has been repeatedly alluded to by many other writers whose opinions have been quoted :—

Report of China-Grass Cultivation and Preparation for Export.

"In submitting, for the information of the Government, the results of my experience in the cultivation of this valuable plant, I wish pointedly to note that my remarks refer solely to that variety of the plant cultivated and known in China under the appellation 'Tchow Ma.' My stock of plants has been derived from seed procured with great difficulty from that country in 1863.

145. "(2) Whether the variety of the plant known in Assam as 'Rhea,' or that known as 'Rami' in the eastern islands, is identical with the Chinese plant, I do not venture to offer an opinion. The Government of India have apparently adopted the former appellation 'Rhea,' in designating the fibre; the American Government have adopted the latter 'Rami.' I have not had an opportunity for comparing growing plants of each variety with mine, but I have had many specimens of fibre from each supplied to me, and there appear to me well-marked distinctions between the three, in colour and texture of the fibre.

146. *Kangra-Plantation Established in 1863.*—" (3) At the time I succeeded in establishing the growth of the plant here (1863-64) the tea plantation at Holta was the property of Government, and several Chinese were then employed there. These men recognized my plants with much surprise, and showed me the Chinese method of separating the fibre.

MR. MONT-
GOMERY'S
EXPERI-
MENTS.

Stems often
12 feet high
and 3 to 4
Crops a Year.
One Root
Affords 176
Cuttings.

Conf. with
specimens 20,
25, 70, 82,
88, 93, 102,
104, 106.

Valuations
of Fibre.

Boehmeria
nivea.

Chinese
Plant.

Chinamen
Recognize the
Plant.

KENTHRIA
cives.

Mr. Montgomery's Report.

PANJAB.

Difficulty
with Seed.
Conf. with
parcs. 17,
52, 51, 79,
83, 124.

Cultivation
for Seed.

Dry Season
Favours Pro-
duction of
Seed.

By Stem
Cuttings.

Distance
Apart.

By Root
Cuttings.
Conf. with
parcs. 39,
52, 79, 53,
83, 92, 102,
104, 128,
142.

Method of
Preparing.

147. *Propagation (4) By Seed.*—"This course must be adopted in some cases, when the germ of the plant has to be carried over great distances; but probably much disappointment will attend the result. To obtain the seed great care is requisite, and a favourable atmosphere season. For this purpose young spring shoots should be carefully reserved in a well-sheltered position. These plants should receive special care and be well manured. During the rainy season they must be kept thoroughly drained, and after that has passed, the ground should be carefully loosened round the plants. If the rains cease early in October, a fair amount of seed may be obtained; but as far as I can judge no amount of care can ensure success, so much depending on the season—a dry one being most favourable for the full development of the seed. The only method of sowing which I found successful was on a gentle bed, under glass, in March and April; the seed scattered over the surface, covered very thinly with sifted earth, and carefully shaded from the sun, until the plants were about three inches high, when sunlight may be gradually admitted. When sufficiently strong, they should be planted out a foot apart every way."

148. (5) *By Cuttings of the Stems.*—"The stems should be spring-grown ones, allowed to ripen well and not cut until duly ripe. Then divide the ripened portion of the stem where the cuticle has turned fully brown into short lengths, each including three eyes or buds. Cut a quarter of an inch below the bottom bud and as much above the top one, and place with the centre bud level with the surface. If the weather be damp and cloudy, they will readily strike root, otherwise they will require shading for a week or ten days, the soil being kept moist. As with seedlings, I find a foot apart every way the most advantageous distance, as very few shoots are thrown up the first year."

149. (6) *By Division of the Roots.*—"This is by far the most advantageous and profitable method. The plants for this purpose should be three or four years old. After gathering the spring crop, dig up each plant carefully and remove the earth from the roots. I generally put the mass of roots into running water for a short time; this cleanses them thoroughly, and enables the gardener to see his work clearly. The tuberculous portions of the roots will be found to show a large number of eyes similar to those on a potato. From these carefully separate portions each containing five or six eyes, let the cuts be clean and reject all fibrous and decayed matter. Expose these sets to the sun for a couple of hours to dry the surface of the wounds, and then plant six inches deep, and at the full distance of four feet apart every way. In this way two good crops will be obtained from them the first year."

Results Obtained in Kangra.

(G. Watt.) **CHAMBERLAIN**

given.

150. (7) *Soil and Situation for Plantation.*—"A rich loam suits the plants best, but they will grow in any kind of soil, provided a full supply of moisture be available combined with thorough drainage. The latter is emergently required, particularly during the rainy season, as, should the land be retentive and become swampy, the plants will wholly decay in a very short period. If the land be poor, a liberal supply of manure is requisite, otherwise the stems will be short and weak, yielding scarcely any fibre. In no part of Upper India can the plant be successfully cultivated unless water for irrigation be available during the dry season. The facilities for obtaining an ample supply of water, combined with the moderate temperature at all seasons, renders this district particularly favourable to the plant."

151. (8) *Cultivation.*—"Should the land have been stocked with seedlings or cuttings (paragraphs 4 and 5), then in the following spring, after having reaped the first crop of available shoots, every other plant should be transferred to fresh ground, and put down at two feet apart. The following year the same course should be pursued, taking up each alternate root and replanting at four feet apart. After this the plants may well remain undisturbed for four years, hoeing well between after each crop, clearing away weeds, irrigating moderately during the dry season, and supplying manure where necessary. The only manure I had at command has been vegetable, consisting mainly of the leaves and woody portion of the plant itself, and of tree and vegetable leaves stored up for the purpose with which I mix a considerable amount of wood ashes. With the aid of this only I have kept plants growing in the same spot for upwards of six years; but consequent on the then very crowded state of the ground, the stems were short and very weak. I would, therefore, recommend a thorough removal after four years, the land to be then well ploughed, cleaned and manured."

152. (9) *Gathering the Crop.*—"The periods for reaping will vary slightly according to difference of season. I find that in this district three good crops can be relied on each year. The first during the latter half of April, the second about the commencement of August, and the third about the end of November. It will be found of much advantage to postpone reaping the second, and particularly the third, as long as the condition of the plants will admit. If the third crop be cut in the middle of November, the weather here during the remainder of that month is not sufficiently cold to keep back the new growth; and should the young shoots appear above ground early in January, the frosts which are usual at that period seriously injure them and lessen the spring crop."

"My own experience indicates that the stems should be gathered so soon as the cuticle shows a clear brown colour for about one-third of the

MR. WATT
CONFERS
EXPERI-
MENTS.

Soil.

Conf. with
paras. 40,
41, 42, 43,
74, 81, 122.

Swampy Land
Unsuitable.

Irrigation
Indispensable.

Conf. with
paras. 87,
110, 116,
127, 128.

Transplant-
ing necessary.

Conf. with
paras. 68,
70, 88, 120,
121, 122.

Hoeing
and
Manuring.

Leaves
as
Manure.

Conf. with
paras. 70,
80, 100.

Overcrowd-
ing Weakens
the Stems.

Seasons of
Crops.

Conf. with
paras. 70,
79, 88-9, 94,
100, 110,
120.

Stems Ripen
when Brown
for one-third
the Length.

SICILY.

Mr. Montgomery's Report.

PANJAB.

Buds just
showing.Fibre Weak
Before
this Stage.Top cut off
and Leaves
Stripped.Wands Placed
in Water.Conf. with
para. 58,
54, 79, 82,
100, 129.Ribbons
Scraped.3,000 Plants
to Acre.Yield.
Conf. with
para. 100,
171.6.5 per cent.
Dry Fibre.Percentage
of Water.
Conf. with
para. 121.

length. At this stage, if the soil be good and the plant healthy, the stems will be clean from butt to point, the leaves of a rich dark green above, and pearly white below, and the branch buds at the axil of each leaf-stalk just showing. If gathered earlier than this I find the connection of the fibres very weak, and that a considerable portion separates in the operation of scraping the 'peel.' If allowed a further growth, the axillary branches will have been thrown out which will cause breakages at every point both in peeling and cleaning."

153. (10) *Height of Stems*.—"The average height of stems grown here has been six feet, after cutting off the soft portion at the top. In gathering I supply each coolie with a sharp pruning knife. With this they cut the ripe stems close to the butt; these are removed in bundles by boys to the nearest manure pit. Here the boys cut off nine inches of the top and pass one hand with a gentle pressure from top to butt; this removes every leaf. The stems are then placed in clean water from whence the coolies remove them and separate the peel, which is again thrown into water from which it is withdrawn as wanted by the men who clean it. These lay three or four strips of peel on a flat board, scrape it a few times on the inner side from butt to point, then turn it over and repeat the scraping, which removes the cuticle: it is then hung up or thrown on clean grass to dry."

154. (11) *Distance Apart*.—"Taking the distance of four feet apart for fully bearing plants, an acre will contain (allowing for paths and water channels) 3,000 plants: more than this I find to be too crowded and to increase labour while lessening the actual yield during a four years' period. Thus planted the yield will be a steadily increasing one, and the plants will not show any deterioration."

155. (12) *Yield*.—"From repeated experimental weighings I have deduced the following average proceeds from 1,000 freshly cut six feet stems:—

	B.
Weight as cut	286
Do. when dried	77.5 = 27 per cent.
Do. { fresh peel	83 = 29 "
Do. { dry peel	21.5 = 7.5 "
Do. { fresh wood	203 = 71 "
Do. { dry wood	55 = 19.5 "
Do. clean dry fibre	18.7 = 6.5 "
Do. water	208.5 = 73 "

156. (13) *Influence of Rains on Fibre*.—"If larger stems, from seven to eight feet, be taken the average is less in the weight of peel, but in the outturn of clean fibre it is slightly greater, with small stems from three to four feet. The percentage of peel is markedly greater, but the return of fibre is barely 35 per cent. Moreover, the extra labour in cutting, peeling, and cleaning these small stems is an important consideration.

B. 576-606.

Results Obtained in Kangra.

(G. Watt.)

BOHEMIA
nivea.

The crop cut during the rainy season will always contain a larger percentage of water, and that of clean fibre be found rather less, the fibre being also softer than at the other periods of cutting. This I consider due to the fact that at this period the resinous matter in the plant is in a more diluted state, and consequently a greater portion of it is removed during the process of washing and scraping the peel."

157. (14) *Variation in Quality of Fibre.*—"I have already expressed my opinion against the use of either immature or small stems, as likely to give a result inferior both in quality and quantity; yet I am fully satisfied as to the advisability of not only sorting the crop, as cut, according to length of stem when necessary, but I would further recommend that the peel from all stems of five feet and upwards should be divided into two, and the fibre from the upper and lower portions kept distinct. If cultivated as I suggest, the difference in length of the stems at each cutting will be found very small, the monsoon crop always giving the longest stems."

158. (15) *Decrease Yield.*—"Taking the above as a basis for calculation, and knowing that each plant established as I recommend will give at least an average of six stems during the first year, I assume:"

Plants \times Stems \times Crops \times lb

$$\frac{3000 \times 6 \times 3 \times 15}{1000} = 972 \text{ lb per acre per annum.}''$$

"In earlier estimates, calculating on closely planted crops and stems four to five feet, I was cautious to restrict my estimate to 750 lb per acre, but five years' additional experience has shown me that with proper cultivation 1,000 lb per acre may be fairly assured.

159. (16) *Cost of Production.*—"I would now allude to the cost of growing and separating the fibre into a state fit for export. After a careful review of actual outlay, I estimate this as under:—

Land rent per acre per annum	R s. p.
Cultivation $\frac{1}{2}$ man per acre at Rs 5 per mensem	10 0 0
Cutting and training stems, two men for three months at Rs 4 per mensem each	15 0 0
Peeling and scraping, seven men at Rs 5 per mensem each	24 0 0
Native supervision at Rs 10 per mensem, for 50 acres, say	105 0 0
Cost of 950 lb of fibre	2 8 0
	156 8 0

TOTAL . Rs 69 0 0 per ton,

* This estimate, though doubtless the final results of six years' cultivation, is based on averages: 3,000 plants to the acre, each supposed to give six stems all of the same length, three crops of such stems all affording the same weight of fibre. At the same time I believe that estimate is very likely to be correct, and in Assam is probably exceeded.—G. Watt.

R. 172-213.

MR. HONG-
GONNET'S
EXPERI-
MENTS.

Crop of Rainy
Season Softer
and less
Gum.

Quality of
Fibre.

Conf. with
paras. 12,
26, 137, 140.
Stems should
be Assorted.

Desirable
Assort Fibre
of Top Half
Distinct from
Bottom Half
of Long
Stems.

Yield per
Acre.

1,000 lb.
Fibre per
Acre.

Cost of
Production.
Conf. with
paras. 3, 5,
24, 43, 65,
71, 81, 82,
85, 87, 103,
140.

BEHMERIA
nivea.

Mr. Montgomery's Report.

PANJAR.

Machinery
versus
Chemicals.
Conf. with
para. 9, 43,
76, 81, 87,
101, 119,
124, 126-8.

Retting a
Failure.

Fibre as well
as Gum
Decomposed.

Machinery
Employed
that Used for
Waste Silk.
Conf. with
para. 9.

of which Rs 247-5, or 67 per cent., has accrued in the preparation only of the fibre. This outturn has been obtained under the strictest supervision, and I do not think more could be obtained by native hand labour when doing daily work."

16a. (17) *Separation of Fibre.*—"The best means of reducing the excessive cost of production have been, and are now being, earnestly sought for, and the result is anxiously awaited. Many anticipate that the separation of the fibre may be effected by mechanical means, others that the object may be obtained by chemical processes. Hitherto I think we have been led astray by our knowledge of the Chinese method of preparing the fibre. But so far as I am informed, the Chinese do not use the fibre in a spun state, but that of divided filaments united into threads by manipulation peculiar to themselves. This process would be equally suitable and expensive in Europe as that of the first separation of the fibre has been shown to be.

"We want the fibre in a state in which it can be at once operated upon by machinery and reduced to yarn, and I am deeply impressed by the conviction that this may be accomplished without the aid of any expensive machinery, and of the mechanical power requisite to work it."

16t. (18) *Retting the Fibre.*—"The plan of retting as applied to flax, hemp, sann, jute, etc., is stated to have been in some localities successfully employed with China-grass. I have tried it in every manner at my command on the green and dried stem, as well as on the green and dried peel in running water and in stagnant, both cold and heated. The results have been uniformly unsuccessful. From the peel retted in N 3 water, frequently changed, the fibre was cleanly separated and boiled well; but after rinsing and drying was found worthless, being weak, dull and discoloured. In all other attempts the fibre itself decomposed equally with the resinous matter. I may add that I have succeeded in growing and retting flax here which has been valued in England at £6-5-0 per ton, so that my management in retting could not have been so very inaccurate as to have solely caused my failures in these attempts."

16z. (19) *Spinning.*—"When proceeding to England in 1871, I took with me from the produce of this estate, dried stems, dried peel and hand-cleaned fibre. All these I succeeded in getting experimented upon by manufacturers who had been accustomed to working the fibre. I may here remark that Dr. Watson refers to the fibre having been worked up by the aid of machinery used for the preparation of flax and wool. Mine was prepared by the machinery used for the utilising waste silk, and China-grass, in the state in which it is usually imported, goes through precisely the same process, stage by stage. The result of these operations

B. 576-606.

Results Obtained in Kangra.

(G. Wall.)

BEHMERIA
nives.

showed clearly that both dried stems and peel could be operated upon, each giving a good clean fibre. My cleaned fibre suffered a loss of barely 9 per cent. in preparing it for the operation of the machines. Dr. Watson estimates the loss at 25 to 30 per cent. I can fully understand this after examining the specimens of Rhea and Rami I obtained in England. These I doubt not were roughly prepared in the manner described in that gentleman's report (page 37, column 2) where a bunch of the peel is tied by one end to a hook and a scrape on each side of each strip is supposed to finish the work. In this procedure a large amount of evaporation must have taken place before each strip of peel had been operated upon. In my procedure there was no opportunity for evaporation until the clean fibre was exposed to the air; and the repeated scrapings on both sides of the ribband of peel, water being frequently applied during the process, must naturally have removed a much larger portion of the gum and resinous matter than the rude procedure stated."

163. (20) *Freight Charges*.—"With the knowledge at present attained it is evident that, however cleanly prepared, the fibre of China-grass has to undergo a manipulatory chemical process prior to machinery acting upon it. This process involves the use of heat, cheap chemicals, and appliances of small cost compared with machinery. I have already endeavoured to show that operating on the plant in its fresh state must be most profitable, inasmuch as under the present system the cost of carriage is reduced to far less than it would be by transport of the produce in any other form not yet known."

164. (21) *Advantages of Cleaning Locally*.—"As this chemical process is the first step enforced on the manufacturer, and by it the fibre loses portion of its weight, it would evidently be most desirable that the process should be carried out by the cultivator, or in his immediate vicinity, who would thus save to to 30 per cent. in cost of transport, besides obtaining a better price for his produce. The results of the experiments made for me in England, showing that clean fibre could be extracted from the dried peel, without the aid of machinery, naturally forced upon me the conviction that a similar process would be equally effective on the fresh peel, and as in the latter case the gum and resin would be in a liquid state, they would be far more readily acted upon than after they had been dried and concentrated; therefore that weaker and consequently less expensive solutions would produce the desired effect. I have not had means at my command to procure appliances properly constructed for the purpose, but I have fully satisfied myself of the feasibility of my idea of procedure, and that it will dispense with all costly machinery in the preparation of the fibre in this country unless it be desired to

MR. MONT-
GOMERY'S
EXPERI-
MENTS.

Loss of Fibre.

Value of
Water during
Scraping.Conf. with
per cent. 50,
54, 77, 82,
100, 120,
155, 161-2.Cleaning and
bleaching
should be
done on the
Plantation.Gum in Liquid
State.Weaker
Chemicals
Required.Conf. with
per cent. 51,
54, 77, 80.

RUSSIA
Notes.

Mr. Montgomery's Report.

RUSSIA.

convert it into yarn, and then weave it, in which case a factory properly fitted must be established.

Deer-tailer.
Conf. with
para. 210.

Hand Dece-
tion
Slow.

Outlay on
Improved
Plant.

165. (22) *Mechanical Contrivances for Peeling.*—Many years back I recollect reading an account of an instrument or small machine which had been invented in America for the use of basket-makers, by the aid of which one man could peel as many osiers in a day as would formerly have employed a score. One or more instruments of this kind, according to the size of the plantation, would meet our first want, as peeling the China grass stems even by an expert hand is a slow process. A properly constructed and fitted boiler in which to subject the peel to the action of the chemicals is the next requirement; and some suitable vessels in which to thoroughly wash the cleaned fibre would complete the necessary plant for the factory. The interest on the outlay for these, added to cost of chemicals used, would, I firmly believe, not amount to one-fourth of that of hand labour as at present, and be a small sum compared with the cost of machinery and engine-power to drive it."

Twelve Years
Experiments.

166. (23) "I fear the above expression of my ideas will be considered very startling, and I should not have ventured at present to promulgate them had not this report been asked for by Government. I have now given my opinions, and, with due deference to those of the many clever men whose attention has been devoted to this subject, I believe they will be found worthy of consideration. I have spent twelve years and utterly exhausted my means in the persistent effort to firmly establish China-grass as an important product of this district, and I still trust that some other individual will benefit by my losses and succeed where I have failed from want of means to protract the struggle."

Suitable Land
for Rhea.
Conf. with
para. 21,
220.

167. (24) "It was my earnest wish to have forwarded a specimen of my fibre prepared in the manner stated, but I have not been able to obtain the necessary materials. Should I do so shortly, a specimen shall be sent."

168. *Future Prospects.*—Mr. Montgomery's failure may be attributed to want of funds, to his not possessing machinery and appliance to reduce cost of cleaning fibre and to the low price usually paid for his hand-cleaned flasse. The success that attended his efforts with the cultivation of the plant, would seem to point to a rhea industry being possible in that district and perhaps in some parts of Gurdaapur as well. Much suitable land might be had at reasonable rates, labour could be readily and cheaply procured and possibly river or canal irrigation easily available. But the distance from the seaboard would tell even more seriously on rhea than it

Results Obtained in Kanga.

(G. Wall.)

BEHMERIA
niven.

has done on tea. Indeed it may be said rhea would stand a poor chance, remote from the localities where the tea plant is being grown, and within these would have practically to contend with that product for both the capital and enterprise of the Europeans.

It is nowhere grown by the Natives and is not likely for many years to come to be engrafted on their agriculture. They have other and more convenient crops that give them quite as high a return as ever rhea is likely to do and that too with one-half the labour and with none of the liabilities that rhea contracts would involve. Still it must be admitted that a small farm like Mr. Montgomery's that can to the present day yield stems 8 and 12 feet in height after a continuous production of over 30 years cannot be said to prove the futility of future efforts.

So many persons have endeavoured, yet failed to establish rhea plantations in India that perhaps Mr. and Mrs. Montgomery are no exceptions, but their patience and devotion till death in their self-imposed task, is truly pathetic. They have now passed away and very possibly the future interests in the scene of their labours will be in recording how many years it may be before all trace of the China-grass has vanished from the Ram Bagh.

MR. MONTGOMERY'S
EXPERI-
MENTS.

Rhea
stems
Too.
Conf. with
para. 84.

CULTIVATION IN THE NORTH-WEST PROVINCES
AND OUDH.

N.W.
PROVINCES.

169. *History.*—A volume might easily be compiled from the extensive series of reports, letters, etc., that have appeared in connection with the rhea of these provinces. The plant is nowhere grown by the Natives however and interest centres exclusively in the cultivation of the plant at the Saharanpur Botanic Gardens and in Dehra Dun with a view mainly to supply the material for the two sets of fibre-extracting experiments that were held at the Government Gardens.

170. In an appendix to this paper I propose to reprint a brief history of the rewards that were twice offered by the Government of India and finally withdrawn. The question is of frequent recurrence as to whether these rewards are still open for competition. It will, therefore, very possibly be a matter of convenience to have full particulars regarding these rewards.

Government
Rewards.
Conf. with
para. 85-8.

171. *Reports of Machinery Experiments.*—The reports of the two sets of experiments performed at Saharanpur, have for long

R. 172-213.

DEHRA DUN
RIVER.

Conclusions Regarding the Punjab.

PUNJAB.

Colonel
Hyde's
Calculations.
Conf. with
para. 120.Yield of
Stems and
Fibre to the
Acre.Conf. with
para. 24,
71, 79-80,
81, 83, 84,
85, 87, 89,
94, 99-100,
111, 117,
121, 127,
131, 133,
135, 138,
141.Two or Three
Cuttings a
Year Usual.Conf. with
para. 70,
72, 86, 96,
100, 130,
132.Cost of
Production.Unfavourable
to Extended
Cultivation.

been in the hands of the public, and I shall not therefore attempt even to review them. But since Colonel H. Hyde's report (*4th Oct. 1872*) on Mr. Greig's Machine contains some particulars regarding the yield of plant and fibre, I may be excused furnishing here the paragraph that deals with these points, the more since the facts brought out are frequently referred to by subsequent writers:—

"The quantity of rhea stems sent to the ground subsequent to the 14th was 3½ tons and was the produce of 1½ acres of land. Of this 3½ tons 480lb of short stems were left unworked as refuse, reducing the worked up stems to 7,360lb or 3·28 tons. The fibre when clean and dry, weighed 207lb, the result being 1½ acres of land produced 7,360lb or 3·28 tons of stalk fit to be worked up by the Exhibition's Machine, which machine turned out from that amount 207lb of fibre, which gives:—

About	63 lb per ton.
Or	138 " acre."

It will be observed these figures were obtained from one cutting (the chief one), and it is generally admitted two or at most three cuttings may be obtained, but not of equal value. Three additional cuttings would, however, raise the amount of fibre annually produced to something over 200lb.

172. Sir George King, while Superintendent of the Saharanpur Botanic Gardens, wrote a long and highly instructive paper on the subject of rhea which will be found in the Journal Agri-Horticultural Society of India, Vol. I. (n.s. 1869), pages 400-411. In that paper he remarks, while commenting on the results obtained at Dehra Dun:—

"I think, however, that if well manured and watered, three crops (as is the case of China) might be obtained. It is in the moist climate of Assam that four or five crops may be obtained in a year." Again in another place he says:—"In estimating the return to the cultivator, the plant being in the ground all the year round, both *rabi* and *kharif* land rent must be debited against the crop, and also water rent where irrigation is necessary. Besides this, allowance must be made for more manure than the native cultivator usually puts on his land. But the amount of labour wanted in an established field would not be great."

It will thus be seen that Sir George King fully realized the more serious aspects of any definite efforts being made to establish the crop in the North-West Provinces. The reader should consult the paper in the original, and it will be found to review the question of B. 576-606. .

Results Obtained in N.-W. Provinces. (G. Watt.)

BEHMERIA
nivea.

yield, cost of production and value of the produce, in other provinces up to the period dealt with, but from want of data affords little additional information regarding the North-West Provinces than is contained in the two passages above.

173. Mr. Gollan, the present Superintendent of the Saharanpur Gardens, is entitled to speak with assurance. He has been intimately connected with all the rhea experiments that have been undertaken in these provinces for many years past. At my request he has furnished the report given below, which will be found to confirm, in a striking manner, what I have endeavoured to show while speaking of North Bengal and Assam, viz., that if rhea cannot succeed in its area of present cultivation, it stands a poor chance of succeeding anywhere else in India:—

Saharanpur, dated the 24th July 1896.

174. "With reference to the request contained in your No. 2225, dated the 21st July 1896, I have the honour to furnish you with the following details on the subject of rhea in answer to the questions put by you in the printed circular received with your above-quoted letter.

175. (1) *Conditions Necessary*.—Rhea will grow, or, to be more precise, exist, in nearly all classes of cultivable soils with a minimum of attention, but in order to make it produce long straight wands of good fibre-yielding quality, it requires a warm humid, equable climate, a rich friable loamy soil, which, if further enriched with liberal dressings of fertilizing manures, such as cow and horse dung, bazar refuse, etc., so much the better.

176. (2) *Number of Cuttings*.—In the Saharanpur district, Rhea yield three crops in the course of a year, but four to five crops of wands of indifferent quality can be forced on by cutting the wands prematurely, i.e., before they are sufficiently ripe for yielding fibre of good quality.

177. (3) *First Crop*.—The first or spring crop begins to sprout early in the hot or dry season, and under frequent irrigation, yields wands from 2 to 3 feet long. This crop in order to save it from being smothered by the stronger set of wands which spring up after the breaking of the monsoon rains is cut about the middle of June. The outturn of this crop is light, not exceeding 6 to 7 cwt. per acre, weighed after the wands have been stripped of their foliage. Owing to the shortness of the joints and all round shortness of the wands, it can hardly be considered a crop as far as the production of fibre is concerned.

178. (4) *Second Crop*.—The second or monsoon season crop is the chief, and practically only good fibre-producing crop the plant yields in

SAHARAN-
PUR EXPERI-
MENTS.

Rhea Exists.

Three Crops a
Year.

Comp. with
perac. 75,
78, 82, 86,
100, 110,
120, 125,
172.

Irrigation
Necessary.

Yield.

The only Good
Cutting.

**BOHMERIA
nivea.****Mr. Gellman's Report.****N.W.
PROVINCES.****Length of
Wands.**Conf. with
paras. 70,
72, 82, 84,
88, 100,
104, 112,
122, 128.**Unevenly
Developed.****Seeds Never
Formed.**Conf. with
paras. 17,
22, 31, 70,
88, 128, 172.**Length of
Wands.****One ton of
Green Stems
to the Acre.**Conf. with
paras. 34,
71, 78-80,
81, 82, 84,
85, 87, 89,
96, 99-100,
111, 117,
121, 123,
127, 131,
135-6, 142,
146, 171.

the North-West Provinces. This crop is ready for cutting about the middle of September. Up to the time of cutting, the wands give no signs of flowering, therefore ripeness for cutting is not guided by the appearance or non-appearance of flowers, but is known by the colour of the wands. When ready for cutting, these have changed from a pale green to a light brown colour. A good wand when ripe, should be 5 to 7 feet long or longer, flexible throughout its length, of a uniform light brown colour nearly its whole length, and the joints between the leaves of as near even length as possible. Wands fully answering to the above description are never produced here. The maximum length of our wands averages 5 feet, and as they invariably begin to become hard and woody at the lower ends before the required light brown colour has extended to their full length, our wands have to be cut while the upper half is still soft and green, and with the fibre in its upper portion naturally not developed to its full strength. Our chief and only good crop of wands is, therefore, cut, while the upper half is unripe, to prevent the lower or most productive portion from becoming too hard and woody for the extraction of the fibre.

179. (5) *Third Crop*.—"The third or last crop of the season springs up immediately after the rainy season crop has been cut, and continues growing until checked by a succession of cold nights or until killed to the ground by frost. This crop is the only one which blossoms, but as the flowers are invariably blighted by continued cold or by frost, seeds are never formed, so the species or form of Rhea grown here (*Bohmeria nivea* or true China-grass) has never been known to ripen its seeds in this climate. The length of wand produced by this third or last crop varies from 1½ to 2½ feet, according as the cold weather begins early or late. After growth has been checked by cold or blighted by frost, the wands, if not cut gradually, wither and die to the ground and the roots lie dormant until the following spring. The outturn of wands varies with the season, but as a rule it is even lighter than the outturn of the spring crop, and, as in the case with the latter, of little account as a fibre-producing crop.

180. (6) *Yield*.—"The monsoon season or chief crop is considered good when it yields one ton of green wands per acre weighed after stripping off the leaves. If cutting is done at the right time, i.e., when the wands have coloured up as far as possible without being too woody at the lower ends, the leaves which are stripped off weigh about a fourth more than the wands. A good crop of wands weighed with the leaves therefore averages 2½ tons per acre.

181. (7) *Percentage of Fibre*.—"The percentage of fibre ribbon to the ton of wands varies with the amount of degumming and cleansing the
B. 576-606.

Results Obtained in the N.-W. Provinces. (G. Watt.)

BEHMERIA
niver.

ribbons are subjected to. If the latter are well washed, and most of the gum and outer bark got rid of, 3 to 4 per cent. of clean ribbon* is the average output. If the ribbons are simply peeled off the wands and dried together with the adhering gum and bark, 5 to 7 per cent., and perhaps even higher, is the average output. I think 4 per cent. may be taken as high yield of well-cleaned ribbons.

182. (8) *Propagation*.—"In the absence of seeds, this garden has always depended upon root division for the propagation of Rhea. It can be raised early in the rains by cuttings made from wands produced by the spring crop, and later on in the rains by cuttings made from wands produced after the rains have begun. Root division is, however, to be preferred as cuttings take nearly two years to form good strong wand-producing stools, whilst roots will form firmly strong stools within a year from date of planting. Root division can be done all the year round, though in the cold weather the roots will not sprout until the advent of warm spring weather, but just before or immediately after the monsoon rains begin, is the most preferable season. The process of division is extremely simple. All one has to do is to cut the roots up into pieces 2 to 3 inches long, in dry districts lay the ground out after it has been well manured and thoroughly broken up with the plough, in beds for irrigation, and plant the pieces of root in patches of three or four pieces 3 inches below the surface of the ground, in rows at 18 inches apart and the same distance asunder between the patches in the rows or even a little closer when roots are available in abundance. It is, however, not advisable to plant too closely, or it will be difficult in after years to stir and manure the ground between the stools. If the soil is naturally rich and has been well manured before being planted up, no further manuring will be essentially necessary until after the lapse of two seasons, but Rhea being a gross feeder and exhausting crop to land, annual heavy dressing of manure will be necessary after it has occupied the land for two consecutive seasons.

183. (9) *Not Cultivated by the Natives*.—"Rhea is not known in this district outside of the Botanical Gardens, therefore it possesses no local or vernacular name.

184. (10) *Cost of Production and Price of Produce*.—"I do not look upon Rhea as a crop that can be grown with profit in the

* It is not quite clear whether "cleaned ribbons" should be read "cleaned fibre." The estimate of 1 ton green stems appears to be the chief crop only: the other two crops very possibly might add another ton or, at 4 per cent. cleaned fibre, a total yield of 1790 per acre per annum.—G. Watt.

BEHMERIA
niver.

3 to 4 per
cent. Clean
fibre.
5 to 7 per
cent.
Ribbons.
Conf. with
para. 171.

Stem
Cuttings,
Root Cuttings,
Conf. with
para. 82,
83, 79, 83,
84, 89, 103,
104, 129,
131, 143,
144.

Reason of
Planting.Method of
Planting.

Subsequent
Manuring.
Conf. with
para. 79,
79, 82, 83,
84, 89, 103,
104, 129,
131, 143,
144, 171.

Crop not Re-
commended
for
Upper India.

BEHMERIA nivea.

Mr. Gallan's Report.

N.-W. PROVINCES.

Price.

Conf. with
paras. 3, 4,
84, 43, 82,
71, 81, 83,
84, 100, 110,
106, 106,
106, 106,
106, 106.

Railway Charges.

Dehra Dun.

Price Paid
Requires to
be Tripled or
Quadrupled.

Ribbons at
£28 a ton
would not be
extravagant.

Succeeds Best
where Tea
Grows.

Conf. with
paras. 84,
102.

North-West Provinces, or anywhere in Upper India, at the price I understand from an article lately published in *The Pioneer*, as at present being offered at Bombay for the ribbons. In that article, mention is made of the low figure of £7 per ton as the present price of ribbons delivered at Bombay (*see paras. 136, 188 (8)*). Taking Saharanpur as a centre for calculation, freight alone upon a ton of unpressed Rhea bales amounts to Rs75-4-0, which converted into sterling at one shilling and two pence per rupee, amounts to £4-7-9½, leaving a balance of £2-12-2½ per ton for the grower to meet cost of cultivation, cost of stripping the ribbons from the wands, and cost of drying, packing and delivery at the railway station, etc. In the comparatively dry climate of Upper India, the cost of cultivation is very high, as the absence of atmospheric humidity and equable tropical warmth at certain seasons of the year has to be compensated for, in order to secure which at the best is only a light crop, by choosing the richest of soils further enriched with expensive dressings of fertilizing manures and frequent stirrings of the soil between the plants.

185. (11) *Kangra and Dehra Dun*.—"Saharanpur is certainly not a good spot for Rhea cultivation, but it is typical of large stretches of country in Upper India. I will admit that there are a few favoured spots in Upper India where Rhea thrives better and may cost a little less for cultivation than it does here; Dehra Dun and the Kangra Valley for instance, but even in such districts its cultivation cannot possibly pay at the price quoted.

186. (12) *Rhea versus Tea*.—"Both these districts are a considerable distance from the line of rail, so after meeting the extra charges caused by road transport, cost of production would be on much the same level as at Saharanpur and other places near the railway. If the quoted price were tripled or quadrupled, it might be worth while for planters at Dehra Dun and in the Kangra Valley to try experiments with Rhea cultivation, but even at a quadrupled rate (£28 per ton) the growers' profits would not, in my opinion, be at all extravagant.

"I may remark in passing, that the two districts I have named are tea-growing districts, and that I look upon tea cultivation as good objective to hold in view when looking for likely spots for the, perhaps, eventual profitable cultivation of Rhea. Where tea thrives, I believe Rhea will thrive, and also that it will cost less for cultivation than in districts of which Saharanpur may be taken as the type. Moreover, where tea gives the best results, Rhea will, I have no doubt, be found to give the best results. Dehra Dun and the Kangra Valley are not to be compared with some parts of Assam and Ceylon as paying tea-producing districts, and I am firmly of opinion, neither will they compare with the latter districts as paying rhea-producing centres.

B: 576-606.

Results Obtained in the N.W. Provinces. (G. Wall.)

BOEHMERIA
nivea.

187. (13) "To sum up in conclusion, rhea, as I have already indicated, will grow or exist with little care in the most indifferent of soils almost anywhere in India. If the price procurable for the ribbons should in the near future rise sufficiently high to encourage speculation in its cultivation, I believe districts favoured with naturally rich soils and warm equable climates will in the long run entirely oust the most favoured Upper Indian districts in its cultivation. I, therefore, take this opportunity of warning the Upper Indian planter, to make sure of his ground by experiments on a small scale, before he largely sinks his capital in Rhea cultivation."

SARAN-
PUR EXPERI-
MENTS.

Rhea Will
Exist
Anywhere.

188. *Other Provinces of India.*—It is perhaps hardly necessary for me to add that the entire volume of available evidence most fully supports Mr. Gollan in every opinion, which, after years of practical experience, he has formed. There is nothing to show that rhea can be grown commercially anywhere in the vast plains of the North-West Provinces and Oudh, nor in the Central Provinces, nor in Bombay. Here and there within each of these provinces there are of course sub-montane tracts where some degree of success might be obtained, but experience in South India can hardly be said to justify even these being at present selected for experimental cultivation on a large scale.

Unsuited
to these
Provinces.

CONCLUSION.

189. Under paragraphs 60-75. I have given a summary of some of the leading facts brought out by the study of the rhea industry of Bengal. It may be useful to exhibit here the final conclusions:—

(1) Rhea is not indigenous to India.

(2) It is fairly extensively grown by the inhabitants of a few of the districts of North Bengal, throughout the greater part of Assam, and in Upper Burma. But it is nowhere else raised as a fibre crop by the people of India.

Indian Area
of Prospect
Production.

(3) While the plant may be grown as a garden curiosity almost anywhere in India, the experiments to establish production on a commercial basis have hitherto been attended with scant success, and mainly because they were performed in localities that it might have been foreseen could give little prospect of success.

Chief Experi-
ments Per-
formed in
least likely
Localities.

(4) It seems fairly conclusively shown that the future endeavours to establish rhea as a commercial product will have to be restricted to the localities indicated, namely, the districts where for centuries very possibly it has been grown by the people as a

RHEA RHEA.

Conclusion.

CONCLUSION.

Correspondence to the
Rheas Area of
China.
Conf. with
para. 66.

Reductions in
Cost of
Production.

Cost of Hand
Cleaning.

Has to Com-
pete with
Tobacco and
Ginger.

Has to Com-
pete with
Tea.
Conf. with
paras. 23,
101, 106.

Available
Land in
Bengal.

Assam has
the best
Climate.
Prospects of
Burma.

regular crop. These have been spoken of collectively (in the foregoing remarks) as a sub-montane tract that lies between 25° — 30° and 28° north latitude. If to this be added the Kangra district, the Indian area of successful cultivation is carried to the 32° north latitude. In other words the most southern extremity (Rungpur and Bogra) is approximately in the latitude of Canton and a portion of Formosa and the most northern point (Kangra) is in the latitude of Nanking. Thus the Indian region indicated corresponds fairly closely in point of latitude to the more important Chinese area of production.

(5) It is of necessity an expensive crop, for it occupies the soil for several years, requires much manure and careful protection from animals. The fibre is difficult to separate, and clean, and hence a cheap and effectual machine or process is as much a desideratum now as it ever has been. Unless great reductions can be effected in fibre extraction, India does not seem likely to be able to produce clean fibre at less than eight annas a pound or, say, £72 a ton, exchange being 1s. and 4d. to the rupee. By hand labour the cost of separation and cleaning comes to between 50 and 60 per cent of the total cost of production.

(6) In the agricultural systems of the Bengal region of present production, it has to compete with tobacco and ginger. Unless therefore, it will pay as well if not better than these crops, an extended production on the part of the Native cultivators cannot be looked for. It does not compete with rice and jute, since it commands the high lands and rich loamy soils.

In Assam it has to compete with tea and will require, therefore, to give reasonable prospects of a good margin of profit, before it can ever succeed in diverting European capital and enterprise from one of the most securely established of Indian industries.

(7) In Rungpur it would very possibly be extremely difficult to obtain suitable soil at reasonable rates. In Jalpalguri and the Duars much good rhea land is no doubt available, and in these districts the labour question would very possibly be much less serious than in Assam, though the climate of Upper Assam would seem by far that best suited to the plant. The backwardness of Burma, especially within the Shan States, where alone this plant seems to be regularly grown, will very possibly stand in the way of that country being taken into immediate consideration by intending planters. Outside the districts of existing

B. 576-606.

Conclusions.	(G. Watt.)	BOHMERIA niven.
<p>cultivation Kangra would seem, in point of locality and climate, the most hopeful. Rhea has been shown to give in Kangra a very much higher yield than in the districts of South India where fairly extended experiments have been conducted.</p>	<p>(8) Lastly, until a few hundred acres of land in Rungpur, in the Deora, in Sibaagar, in Lakhimpur, in Upper Burma, and in Kangra have been systematically cultivated for a term of years, we shall not possess the data upon which to decide whether or not rhea production can be made profitable in India. But I feel constrained, after a fairly careful examination of every aspect of the question, to affirm that under no circumstance can ribbons be produced in India at the figure recently demanded, namely, £7-10 per ton. Until, therefore, the great merits of the fibre are recognised and much higher prices offered than at present, it is quite useless to look to India as country of supply.</p>	<p>CONCLUSION. Prospects of Kangra. Prospects of South India.</p> <p>Further Experiments Essential.</p> <p>At Low Prices India Cannot Compete.</p>

VILLEBRUNEA
integrifolia.

Ban-Riha.

**III.—Villebrunea integrifolia, Gauch., Bot. Benile Voy. 1. 37;
Fl. Br. Ind., V., 389; URTICACEÆ.****DON OR BAN RÍHA: WILD RHEA.**

190. *Syn.*—Blume Mus. Bot., II., 166; *URTICA ACUMINATA*, *Fl. Ind.*, III., 592; *VILLEBRUNEA APPENDICULATA*, *Wedd. in DC. Prod.*, XVI., I., 235; *ORROCHIDE ACUMINATA*, *Kurz. For. Fl. Burm.*, II., 427; *URTICA APPENDICULATA*, *Wall. Cat. No. 4604*; *CELTIS ELONGATA* and *TETRAANDRA*, *Wall. Cat. Nos. 3692 C. and 3692 F.*

191. *Vern. Names.*—*Ban* (*don-riha*) (wild rhea) is the name for the fibre, the plant being *Ban kothora*; the (true *kothora* is *Vangueria spinosa*) *Ass.*; *Ritsa* (or for brief *Rca*) *Jabaka Naga*; *Jutis*, *Naga Lookoy*, *Singpho*; *Lipic*, *Paharia*; *Kaphitki*, *Lepcha*.

192. *References.*—*Robinson, Assam* (1841), 67; *Thomson, J. Agr. Hort. Soc. Ind.*, Vol. VI. (1848), 184; *Hannay, J. Vol. VII.* (1850), 222-23; *Royle l. c. In.* (1857), *Select. p. 230*; also in *Fibrous Plants*, pp. 355-56; *Watson, Rep. on Rhesa Fibre* (1875), p. 1; *Gamble, Trees, Shrubs, etc. Darjeeling*, p. 77; also *Man. Timb.*, p. 325; *Watt, Sci. Rep. Govt. of India*, Vol. I., p. 315; *Cross, Bevan and King, Report of Indian Fibres*, p. 34; *Talbot, Trees, Shrubs, etc. Bombay*, p. 197.

193. *Habitat.*—Met with plentifully at the foot of the Eastern Himalaya from Sikkim to Nepal; throughout the valley of Assam, especially near the foot of the hills, and distributed within the Assam hills from the extreme north through the Naga country to the Khasi and Garo Hills, thence to Manipur, Cachar, Sylhet and Chittagong; also the mountainous tracts of Burma (as far as Tenasserim) and to the Yunan Province of China. So again it occurs in the damp valleys of the higher Konkan Ghats and is distributed to the Andaman Islands.

It frequents damp glades near streams but with its roots above water level and is often so extensively pollarded that it resembles in some respects a large leaved willow. While passing through the Nambar Forest I heard of a place known as *Riha-kata-jan* that was famous because being the head-quarters of the Mikir collection and preparation of *ban-riha* fibre.

194. *Citation of Collections and Authors.*—In the Royal Botanic Gardens' Herbarium there is a very extensive series of speci-

V. 133.

Distribution
of the Plant.



Rha-Rha.

(G. Wall.)

VILLEBRUNEA
integrifolia.

ment by Jenkins who sent it from Gauhati with a note on the label - This is the *Rha Rha* from which China-grass cloth fibres are prepared - Wallich, Nos. 4604 and 3692 from Sylhet; Griffith No. 4577 from East Bengal; Hooker & Thomson from the Khasia Hills; Masters from the Naga Hills; Mann from the Duffla Hills; Kurz & King from Sikkim, and Gibson from Western India, etc., etc.

Standard
Collections.

It has thus been fully recognised by botanists and has not infrequently been mentioned as the plant that afforded the *Rha-rha* fibre, but in no instance is it stated as being cultivated. It is purely an indigenous plant, but because of its being called *Rha* (wild) *rha* arose the very mistaken notion by writers who had very possibly never seen it that it was the wild plant from which by cultivation the rhea had been developed, and the still more pernicious error that, seeing that rhea was thus wild in India, the fibre could be procured for little more than the cost of collection. As fully illustrative of this error I may give the following passage from Dr. Forbes Watson's Report. While speaking of the history of rhea he says, "The matter then dropped until about 1840 when attention was again directed to it by Colonel Jenkins, who discovered the same plant growing wild in Assam and transmitted a few specimens to the Agri-Horticultural Society of Calcutta." Now neither Jenkins, Hannay nor Dalton ever say they found *B. nives* wild, but are most careful to mention that the *Rha-rha* (or so-called wild *rha*) plant is perfectly distinct from the cultivated *rha*. The nearest approach to making this mistake is the record on a label of one of Jenkins' plants already quoted, but even he nowhere makes that statement in any of his letters or reports.

Pernicious
Error.
Conf. with
paras. 8-7,
77, 127.Early Investi-
gators
Never
Mention it
as Wild.Wild Rha.
Conf. with
paras. 8, 7,
41, 42, 44,
47, 50, 76,
77, 83, 126,
127.

In this connection it may be added that, although the plant is found in the Konkan, the people of Western India do not appear to have discovered its great textile merits. At all events none of the European writers on the botany or economics of Bombay Presidency so far as I have been able to discover, allude to the fibre.

195. *Description*.—A small ever-green tree or large bush, which, when pollarded, produces many erect straight branches, 5, 10 or 15 feet in length. *Leaves* 6-14 inches long, elliptic oblong, caudate entire or when young obscurely crenate, pinninerved (8-15 pairs), membranous and tomentose, the leaves of staminate plants much more velvety than of the pistillate; *petioles* 1 to 6 inches long; *stipules*

VILLEBRUNEA
integrifolia.

Ben-Rhea.

silky villous. *Flowers* very minute, the males (staminate flowers) on one plant and the females on another; clustered on small dichotomously branched cymes, that are situate on the lower portions of the branches below the leaves or around the scars of fallen leaves; male clusters considerably longer stalked and more open than the female; male flowers 3-4 merous, the perianth adnate to the ovary and to the achenes.

Plate III.

196. Plate No. III represents this plant. It was obligingly furnished me by Dr. Prain and is a reduction and adaption of Gaudichaud's table 91, the original representation of the species. Dr. Prain has furnished the following descriptive note regarding the plate:—

197. *History of the Fibre*.—Colonel Hannay was the first who drew definite attention to this fibre; he did so in his paper on *the Rheas and Nettle Grasses of Anam*."

Is a Forest Tree.

"This is a jungle plant, he says, common in most of our forests, the best in the vicinity of water or running streams. When uncultivated it grows to a tree, but, by proper management, any quantity of young shoots can be obtained, and as the divided roots afford numerous slips and the plant can be propagated by slips as well as by the seed its cultivation for its fibre might be carried on, the same manner as practised in Europe with the willow. I have shewn the leaves of this plant to the Chinese here, who say the fibre is exported into Southern from Northern China. It is cultivated largely by the hill tribes on the North-West Frontier to a small extent only, for a coarse cloth but chiefly for nets. It is recognised by the Nepalese as *Loopash*. Samples of this fibre have been most favourably reported on by Captain A. Thomson (see Journ. Agri.-Hort. Soc., Vol. VI., p. 184)."

Reported to be Used in China.

Said to be Cultivated in Yunnan.

Made into Cloth. Captain Thomson's Report.

Captain Thomson's report was to the effect that the fibre was all that could be desired for either canvas or lines and only required to be known to be generally used for these purposes. Samples of

* *Villebrunea integrifolia*, Gandick.Reproduced (in part) from *Voyage de la Bonita Atlas*, t. 91.

1. Part of flowering branch (female).
2. Part of flowering branch (male).
3. Young male flower.
4. Male flower, fully open.
- 5, 6, 7. Stamens at various stages.
8. Pistil, abortive, surrounded by 4 filaments.
9. Bract.
10. Female flower.
11. Pistil in vertical section the perianth removed.
12. Stigmatic hair enlarged.
13. Ovule.

Ban-Riba.

(G. W. H.)

VILLESBRUNEA
integrifolia.

this wild rhea fibre appear to have been sent home from Major Hannay's collection, and Royle informs us that he had submitted them to the Society of Arts (*Journ.* 9th December 1853, pp. 60-61).

In a paper which will be found in the *Journ. Agri.-Hort. Soc. of Ind. Solutions* to Vol. IX. (1857), p. 23, Royle says of the *ban-rhea* :—

“No information is given respecting the plant yielding it, but it is no doubt one of the untile tribe, and, from being called *ban* or jungle rhea, it has been inferred that it may be the *rhea* in a wild state. But though we have no proof of this, it is satisfactory to find that Major Hannay describes it as ‘uncultivated, but very common in all parts of the province’ and again ‘common in most of our forests.’”

198. *Comparative Strength of Ban-rhea Fibre.*—Royle then furnishes the following table to show the results of the comparative tests that had been performed with several Indian fibres including Major Hannay's cultivated Assam rhea and his *ban-rhea* :—

“ Petersburg clean Hemp	160
Jubbulpore Hemp	190
China-grass	250
Rhea Fibre	320
Wild Rhea	340 ”

It will thus be seen that, according to these figures, the *ban-rhea* was proved to be stronger than the China-grass (presumably from China) and the rhea (presumably from Assam).

In another part of his paper Royle furnishes the results that had been obtained by Messrs. Huddart & Co. from their Rope Manufactory Limehouse, on the 13th February 1854 :—

Report on Experiments on Strength of Rope made from samples of Rhea and Ban-rhea Fibres from Assam, received from the East India House.

DESCRIPTION.	Size of rope.	No. of yarns per strand.	Total number of yarns in rope.	Strength of rope in lb.	Strength of rope per inch of circumference squared.	Size of rope at breaking.	Tar absorbed.	Amount of stretching.
Wild Rhea, 1st experiment.	4	44½	132	19,032	844°	4½	1-7th	1 in 16
Wild Rhea, 2nd experiment.	4	44½	132	20,124	891°	4½	1-7th	1 in 16
Rhea Fibre.	4	44½	132	20,488	910°	4½	1-9th	1 in 16

* The average strength of rope made with the best hemp and after numerous experiments from 1803 to 1808 is 805.

VILLEBRUNEA
integrifolia.

Bas-Rhea.

Present
Knowledge.

199. It will thus be seen that the *bas-rhea* fibre was found to be quite as strong as the true rhea of commerce. It is an extremely abundant plant, occurs in all the damp valleys of Assam, it is highly valued by the hill tribes, by some of them even preferred to the true rhea, and yet we know no more about it in European commerce to-day than was made known to the world half a century ago, through the combined labours of Major Hannay, the Agri.-Horticultural Society of India, and Dr. J. Forbes Royle.

Previous
Reports.

I have already given in the Dictionary and elsewhere a fairly complete statement of available information compiled from the standard books that deal with Indian Economic Products. These articles can be consulted, therefore, by readers who may desire a sketch of the earlier opinions. It very possibly, however, may be more useful to planters and others, who contemplate opening out experimental plots of this plant, if I give a brief abstract of my personal investigations and of the opinions of those whom I have consulted. I shall give here accordingly a selection from the letters and communications received from practical men whose co-operation I have been fortunate enough to secure.

Present
Investiga-
tions.

200. *Chemical Examination of the Fibre.*—The sample of this fibre sent to the Colonial and Indian Exhibition having been viewed as doubtfully correctly named, it was not examined by Messrs. Cross, Bevan & King, and accordingly not reported on in their Indian Fibres and Fibrous Substances shown at the Indian Section of the Exhibition. These authors accordingly only make a very brief and somewhat unfavourable allusion to the fibre. In Spons' *Encyclopædia* it is said that "the fibre is more easily separated than that of the preceding (rhea) and is considered one of the strongest in India."

Found in the
Plains of
Assam.

Some short time ago I invited Mr. J. Melrose Arnot, Chemist to the Bally Paper Mills, to examine and report on a small sample of the ribbons of barks which had been roughly stripped by myself from a few branches cut from a plant found on the sloping banks of the Rajghur Ali (an elevated road) near Lackwah, Sibsagar.

Mr. J. Melrose
Arnot's
Report.* Experiment.
Botanical.

I would explain that these ribbons were not scraped nor put through any preparation. My object was in fact to secure the entire ribbon of bark, fibre, and gum, simply dried in the shade. It seemed to me desirable to discover the loss in purification and the degree of resistance, if any, which the gum might make against a mild chemical

Rheo-Rika.

(G. Wall.)

VILLEBRUNE,
integrifolia.

treatment. The plant had been carefully identified by me; the corresponding botanical specimens to the barks were registered as No. 12258 and were collected on the 7th March 1897. It was a male tree in full flower. The tree had not been systematically pollarded and the shoots were old and fully ten feet long and an inch or more in thickness at the bottom. The season of the year was, moreover, my Assamese informants said, not the correct one. The shoots then on the tree should have been cut off and rejected, and the young shoots that would be found on it in June to October alone collected for fibre purposes.

It is necessary in considering Mr. J. Melrose Arnot's report that follows, to bear these unfavourable facts in mind. Mr. Arnot writes:—

"The following figures are the results of the chemical investigation:—

Moisture.	Cellulose.	Mercerization.	Nitration.
11.45	26.01	10.40	129.29

The fibres are beautifully white and of a fine silky lustre, measuring 15 to 30 mm. long and 0.013 mm. in diameter; they are cylindrical or nearly so with a slightly striated exterior thick walls and small central canal; ends tapered. A pecto-cellulose very similar to flax but much finer while being equally long.

"I have endeavoured to make this report in such a way that the results may be strictly comparable with those obtained by Messrs. Cross & Bevan for so many other fibres, but inasmuch as their reports are mostly based on examinations of the hand or machine-cleaned textile fibres, an entirely satisfactory comparison cannot be obtained. I regret also that owing to an explosion of nitro-cellulose in my laboratory one series of experiments was entirely destroyed, but the figures here quoted are the mean of two series.

"I have been unable to obtain a sufficient quantity of fibre of full length (textile filaments) for the purpose of making a strength test to compare with the tests of other fibres made by Mr. Geo. Ashton.

"I have been expecting a fresh supply of the bark from you, but it has not as yet come to hand; I trust, however, that this may prove useful, and when you can supply a quantity of hand-cleaned fibre I would be glad to make a more extended examination.

"As compared with the fibre of *Boehmeria* given this is exceedingly fine, indeed it is one of the finest fibres I have ever measured—and, although not anything like so fine in the individual fibre, the filaments are long and

Condition of
Plant from
which
Derived.Not the
Correct
Season.Chemical
Results.Length and
Thickness of
Ultimate
Fibres.Finer than
Flax.Strength
Test.

Clean Fibre.

VILLESBRUNEA
integrifolia.

Bon-Riha.

More Easily
Workable.

strong, and I have no doubt that in every respect the material would prove more easily workable on textile machinery, and it would undoubtedly produce very much finer textures than *Bombaria nivea*.

Perfect Sub-
stitute for
Linon.

"I have not seen the fibre of *Bombaria tenacissima*, but, from descriptions I have seen, this fibre seems to resemble it very strongly and ought to be the most perfect substitute for linen.

Colouring
Matter.

"The colouring matter contained in the bark appears to be very well worth serious study."

I was unfortunately unable to furnish Mr. Arnot with hand-cleaned fibre for some time subsequent to the receipt of the above report and when procured by me Mr. Arnot was unable to afford the time to prosecute his investigations. The low percentage of cellulose must be very largely accepted as due to the nature of the sample examined.

201. **Yield of Fibre to Green Stems.**—Mr. L. A. M. Lumsden of Nahor Rani Tea Company, Tezpur, at my suggestion has gone into the question of an experimental cultivation of this plant. He has furnished me with a large supply of ribbons cut from wild plants and I trust very shortly, through the Research Department of the Imperial Institute, to be able to furnish a fuller report both as to the chemical and structural peculiarities of the fibre, and its value as a textile. Meantime I may mention the following particulars that have been furnished by Mr. Lumsden:—

Yield of Fibre

"Weight of green branches	36 mds. 32 lbs.
Weight of green ribbons	3 " 30 "
Weight of dry ribbons	1 md. 30 "

These figures may, therefore, be accepted as indicating the value of dry fibre to the weight of green shoots which the plant affords.

Various
Plants Called
Bon-Riha.

202. **Different Plants Spoken of as Bon-riha.**—On my arrival in Assam I made enquiry for the plant known as *bon-riha*. I was on several occasions shown *Urena lobata* as being the *bon-riha*, and Mr. Whigham sent me from Golaghat *Triumfetta rhomboides* under that name, though he subsequently gave *bon-herial* as the correct vernacular for that plant. On one occasion, while in Sibsagar district, I was told that the *bon-riha* was being cultivated at a certain village. I took an opportunity to visit the village and found, much to my astonishment, a small field of *Urena lobata*. Both the above-mentioned plants are well known to afford valuable fibres. Mr. Dowling, of Chittagong, for example, informs me that the *Urena* is there known as *seth* (white) *lehra* and the *Triumfetta* as *leh* (black) *lehra*. Though the former belongs to *MALVACEÆ* and the

Urena lobata.

Triumfetta
rhomboides.

Chittagong
Fibres.

Ben-Rha.

(G. Watt.) **VILLOSRUNEA**
integrifolia.

near to TILIACEAE they are no doubt from the Native standpoint nearly related plants. Mr. W. Leeds, Conservator of Forests in Assam, wrote in 1870 that the *ben-rha* was a species of *Urena* — "A common tropical weed of the order MALVACEAE and not related to the true rhea. The fibre of *Urena* is used for the manufacture of rope and is much inferior to that of *Boehmeria*." It will thus be seen that the error of confusing these jute-like fibres with the *ben-rha* has prevailed for some time in Assam.

203. *Further Particulars Regarding the True Ben-rha.*—Mr. John Phillips, of Sufry, Sibsagar, was good enough to interest himself in my enquiries regarding the *ben-rha*. He not only succeeded in discovering the plant in a glade behind his bungalow, but in securing some Nagas to show me their method of cleaning the fibre. In one of his letters, written subsequent to the date of my visit to Sufry (19th November 1897), Mr. Phillips furnishes useful particulars regarding the name of the plant:—

"I take the name *ben-rha*, he says, to be applicable to the fibre and not to the plant from which it is obtained. The plant is called *ben-kothora*, but whether this is Ahom or Hinduised Assamese I cannot tell, nor can I say why it is called wild *kothora*. The Singpho Doanneas call the plant *leehoy kheen*, the latter word meaning plant or tree. The Nagas in this neighbourhood call the plant *Jutta*.

"I showed the plant yesterday to Mr. Monahan, and he said it was quite different to the plant shown to him as *ben-rha* in Lower Assam which was a decided nettle but different from *Boehmeria nivea*. He said that you would not accept it as *B. tenacissima*."

The *Boehmeria* to which Mr. Phillips alludes is *B. platyphylla*, which not only in Assam but in Bengal is often called wild rhea by the cultivators. But the distinction Mr. Phillips makes in the name *ben-rha* being applicable to the fibre and not the plant, is worthy of careful consideration. It would seem to support the idea already advanced by me that the word *rha* may be but of comparative recent adaptation to the fibre of *Boehmeria nivea*.

204. *Report from the Garo Hills.*—Mr. F. E. B. Lloyd, Officiating Deputy Conservator of Forests, has also given attention to the question of the *ben-rha* plant. In one of his letters he says:—

"I have studied the habits of this tree during the cold weather, and the following facts may be of interest to you. The tree when left unmolested attains a girth of about 2 feet and a height of from 30 to 40 feet. In

Nagas
Demonstrate
Separation of
the Fibre.Name of
Fibre.*Boehmeria*
platyphylla.Derivation.
Conf. with
para. 1d.

VILLESRUHEA
integrifolia.

Mr. Severin's Report.

JABAKA NAGAS.	this district it is found on the hills only, bordering on the Khasia and Garo Hills, but extends all along the southern boundary and is very fairly common. It is only found in mixed evergreen forests and is not gregarious. It thrives principally in shady damp places on the sides of streams, it does not grow at all on the plains or in places exposed to the sun. The tree flowers in March and the seeds ripen in April.
Khasia and Garo Hills.	
Pollarded.	205. Season of Collection. —The method of obtaining the branches which yield the fibre is to pollard the tree during the months of November to February, when the young pollarded shoots will be available in June and throughout the rains. The fibre is extracted from the branches in exactly the same manner as from <i>Bomarea nivea</i> , only the fibre is longer. One man preparing <i>bon-riha</i> can get as much fibre in the same time as three men preparing the cultivated fibre.
Time Necessary to Clean Fibre.	
Fibre Used to Mix with Silk.	206. Uses of the Fibre. —"The fibre is only prepared in small quantities and for home consumption. The people use it in making nets and in certain cases for mixing with silk in making cloth. It can sometimes be bought at the village <i>hats</i> (markets) where the Garos who principally bring down the fibre sell it at Rs per seer."
Price Rs per seer.	
Jabaka Manufactures.	Mr. Phillips was able to secure for me a set of the Jabaka Naga shoulder bags which they weave from this fibre. It is specially selected for this purpose because of the great strength of the texture. These bags are somewhat coarsely woven, but often very beautifully embroidered and the Nagas informed me that the <i>bon-riha</i> fibre takes dye very rapidly. Occasionally the shoulder bags are woven half with cotton and half with <i>bon-riha</i> .
Mixed with Cotton.	
Fishing Lines of Mixed Ebon and Bon-riha.	Mr. Phillips further informed me that rhea fibre did not in his opinion make a good fishing line since when thrown from the reel it was apt to get knotted, but if mixed with <i>bon-riha</i> this did not occur. This property, if confirmed by future investigations, should prove a great additional merit to the <i>bon-riha</i> over the rhea fibre of commerce.
Jabaka Nagas.	207. A Visit to the Jabaka Nagas. —But I cannot conclude this account of the information acquired during my brief investigations in Assam without acknowledging the invaluable assistance rendered me by Mr. T. F. Severin, formerly of Tiok, now of Tingali Bam Sanam. Mr. Severin from having to largely employ Naga labour has been brought into constant association with the Jabakas and other Nagas. He has acquired a knowledge of their language and is permitted to visit their country whenever he pleases.

Mr. Severin very kindly therefore undertook to accompany me on a short run into the Jabaka Naga country with the object mainly

Sen-Rhea.	(G. Watt.)	VILLEBRUNEA integrifolia.
<p>of collecting information regarding this fibre. We found that they cultivated the rhea (<i>Boehmeria nivea</i>) to a small extent and sold the fibre to the people of the plains. Within recent years, the ease with which they have been able to purchase coarse cotton yarns, has disorganised their indigenous textile industries. They bring down heavy loads of Arum (yams) and of the soap nut (<i>Sapindus Mukorossi</i>) and barter these and other natural products of their country for cotton yarn and other produce of the plains. Formerly both the fibre of <i>Girardinia heterophylla</i> (which they call <i>tukak</i>) and that of <i>Villebrunea integrifolia</i> (called <i>rhea</i>) were very extensively used, but at the present day the latter is mainly employed for the warp only of the narrow strips of cloth which are made into shoulder bags. It is understood to give great strength to the bags and is thus rarely entirely omitted.</p>		<p>JABAKA NAGA. Cultivate Rhea. Exports from Their Country.</p>
<p>208. On the ascent to the Jabaka village, where the head of the lam (or Rajah) lives, we were shown the <i>Sen-rhea</i> plant and the crude method pursued in cleaning the fibre. Mr. Severin has since the late of our visit continued his enquiries, and it will more fully meet the case if I publish here some passages from his highly instructive correspondence, rather than to attempt to describe what I personally witnessed on the occasion mentioned.</p>		<p>Operation of Cleaning Fibre Witnessed.</p>
<p>"I hope you have received," writes Mr. Severin, "the three bags of <i>Sen-rhea</i> fibre or ribbons I sent to you via Goalundo by steamer and rail. I should say the three bags weighed about one maund."</p>		
<p>"I have had very little time to make progress with the plant myself, but of course now from May it will begin giving out its light green shoots which alone are used for the extraction of the fibre."</p>		
<p>"<i>Sen-rhea</i> as the Assamese call it, means of course wild rhea, but the Nagas call the same plant <i>rhea</i> or <i>rae</i> for short. It is very plentiful here and near the foot of the hills where it gets a loose soil and plenty of water.</p>		<p>Vernacular of Plant.</p>
<p>209. <i>Preparation of Ribbons.</i>—"The Naga way of producing the ribbons is quite different from the Assamese. The cuttings are best made from May to October—during the rainy season. The quality of the fibre depends on the age of the shoots. In old shoots the fibre is less abundant, is not so strong as is largely intermixed with hard woody or grained tissue. The younger the shoots therefore, the better will be the quality of the fibre.</p>		<p>Young Shoots Yield Best Fibre.</p>
<p>"After cutting, the shoots are carried to the villages where the outside green skin or bark and a little slimy matter is scraped off. Then</p>		<p>Bark and Gum Scraped off.</p>

V. 133.

VILLESBRUNEA
integrifolia.

Mr. Servais's Report.

JARAKA
NAGAS.

Inner Face
of Bands of
Fibre also
Scraped.

Left to Dry
in the Shade.

Steeped in
Water and
Wood-ashes.

Boiled in Rice-
Water.

Hand-picked.

Hard-twisted
Yarn.

Assamese
Method.

Ribbons
Twisted into
Rope.

May be Grown
on Waste
Lands.

Easily
Separated.

Decorticator.

Comp. with
pers. 168
(27).

the ribbons of partially cleaned fibre are stripped off the shoots. The inside of these stripes of fibre is then scraped with the back of the finger. The stripes are then drawn through repeatedly in order to remove the slimy and gummy substances from the inner face of the ribbons. After being as well cleaned as possible in this way the ribbons of fibre are left to dry in the shade. After being fully dried the ribbons next are steeped in water and wood-ashes for about 24 hours and then boiled in rice-water for 4 hours.* The fibre will then be found to be quite free from gum and may be separated into fine threads. This is, however, a tedious process and is mostly carried on by the old people of the villages.

"The thread (yarn) I send you a small sample of, is ready to be woven into cloth. The Nagas believe that the harder the thread is spun the stronger it becomes.

"The Assamese take off the ribbons when the shoots are in a half-grown state and do not first scrape off the outer bark and gum. They also leave the inner face coated with the slimy gum. They purify it in a coarse way by washing in lime and then twist it into twine or simply divide up the ribbons and, without any preparation, twist these into twine to be used for making nets to catch deer in. The Assamese do not spin or weave it, and I do not think they even make fishing lines and nets from it, but for these purposes prefer the silver-leaved *riha*.

"*Bon-riha* will not grow where water stands. You recollect seeing it on the embankment of the Rajghur where it was naturally drained though water was plentiful below."

210. *Conclusion*.—The above abstract of reports and opinions seems to confirm on all points the expectations I originally held out in a paper written in 1887-88 and published in the Selections from the Records of the Government of India.

The *bon-riha* is a plant that can be grown on soils that the true *rhea* plant could not live on. It would require next to no cultivation. There is no difficulty in separating the ribbons of bark since they do not adhere so firmly to the central core of wood as in the true *rhea*. The bark strips off like that of a willow and a machine that would slit the bark and then peel it off might easily enough be devised. Once so stripped the ribbons could be laid flat on a feeding table and scraped both top and bottom, without any injury to the fibre.

* It will be recollected that I have already pointed out that the *rhea* fibre is in various parts of India cleaned by being boiled in rice-water. I have suggested that this fact should be chemically investigated.—G. Wall.

Sea-Rhea.

(G. Watt.) **VILLEBRUNEA**
integrifolia.

None of the mechanical difficulties that beset the rhea industry seem to me to exist in this case. The gum is easily scraped off, and it is by no means so abundant nor so difficult of removal as in rhea. Even if the fibre be considerably less valuable than the true rhea, it could be produced as a by-crop in tea-planting, could be easily and cheaply cleaned, and might thus be turned into the market at a price that would at once command a ready sale.

I do not say that the introduction of this fibre is likely to solve the rhea production problem. But from what I already know of this wonderful and greatly neglected fibre, I have very little hesitation in affirming that the tea-planters in Assam are likely to find the *ben-rhea* a more tractable and remunerative by-crop than rhea fibre itself. It could be grown on the sloping banks of most of the depressions or *hollaks* within the tea estate—lands which at present are not only waste but often sources of positive danger to the tea-plant. The annual crop of shoots from the perennial bushes would be found money and the supply of ribbons could be scraped by hand labour at a very moderate cost—the total charge in fact against production. But no doubt machinery could be designed to greatly reduce even the cost of separation and cleaning.

JARAKA
NAGA.No Mechanical
Difficulties.Comparative
Values of the
Fibres.Remunerative
By-crop to
Tea.Could be
Grown in the
Hollaks.

MAOUTIA
Puya.

Pua-Rhea.

IV.—*Maoutia Puya*, Wadd. in *Ann. Sc. Nat. Ser. 4 I*, 195; *Fl. Ind.*, V., 593; *URTICACEÆ*.

PUA-HEMP: NEPAL RHEA.

211. *Syn. and References*.—*Brandis, For. Flor.*, 436; *Kurz, For. Flor., Burm.* II., 429; *Gamble, Man. Timb.*, 325; *Athanas, Him. Dist.*, 317, 798; *BOEHMERIA PUYA*, Hook., in *Journ. Bot.*, Vol. I. (1849), p. 26; also III. (1851), p. 316, t. 7 (*Excl. Syn. Resb.*); *B. FRUTESCENS*, Don *Prod.* 59 (not of Thunb.) *URTICA PUYA*, Ham. in *Wall. Cat.* 4605; *Rey. Fib.* Pl. 368; *Campbell, Journ. Agri.-Hort. Soc. Ind.*, VI., 135, 142, 240; *Hannay, Journ. Agri.-Hort. Soc. Ind.*, VII., 223; *Madden, Journ. As. Soc. Bengal XVIII. I.*, 622, *Watson, Report Preparation and Uses of Rhea Fibre* (1875), 100 (reprints from *Hooker, Journ. Botany*, Vol. III.).

212. *Vern. Names*.—*Poi, pua*, Hind.; *Yenki*, Limbu (Sikkim); *hyinki, kienki*, Lepcha (Sikkim); *Puya*, Kumaon, and *Pullant*, Almora in the North-West Provinces it appears often to be called *bar-rhea* (wild rhea); *Puya*, Nepal; *Sat sa*, Burma. There would appear to be several plants that go even more generally than *Maoutia* by the name *Sat sa*, *sat-sha* or *sap-sha*. Of this nature I would mention *Trema orientalis*, *Sarcochlamys pulcherrima* and *Boehmeria Hamiltoniana* as plants that belong to the same natural order and yield fibres of similar character to that of *Maoutia Puya* which seem in Burma to all receive the same vernacular name.

213. *Description*.—A shrub 2 to 6 or 8 feet in height, branches pubescent. *Leaves* alternate, on fairly long and slender petioles, ovate elliptic, cuneate, caudate-acuminate, 4 to 6 inches long; coarsely dentate-serrate, 3 veined (the veins coloured below through their coating of hairs), dark green and scabrid above, silvery-white below; stipules lanceolate very hairy. *Inflorescence* axillary and terminal cymes, dichotomously branched, slender. *Flowers* minute sessile or nearly so, monoecious or dioecious, in small heads; *male* heads larger than the female, stamens 5 opposite sepals; *female* perianth ovary straight stigma penicillate; achene gibbously ovoid trigonous adpressed-hispid ovule erect.

Plate No. IV has been reproduced from *Hooker's Journal of Botany*, Vol. III., Pl. 7.

M. 260-265.



MADIA PIVA

Litho., S. I. O., Calcutta.

Pm-Rhe.	(G. Watt.)	MAOUTIA Puya.
<p>214. <i>Habitat</i>.—Fairly plentiful in the damp forests at the foot of the Himalaya from Garhwal eastwards to the Khasia Mountains and Burma.</p>		<p>Original Discovery Possibly Confused with Rhe Conf. with para. 29, 44.</p>
<p>215. <i>History</i>.—Dr. Campbell, while Superintendent of Darjeeling, wrote an account of this fibre in 1847 which was published in the Journal Agri-Hort. Society of India, and has been re-published under numerous editorial transformations by every subsequent writer on this fibre. The specimens collected by Dr. Campbell were subsequently identified by Dr. Falconer, at that time Superintendent of the Royal Botanic Gardens, Calcutta. I have already mentioned the circumstance of the only specimen in the Calcutta Herbarium collected by Dr. Campbell having been wrongly named <i>Maoutia</i> or rather "<i>Pooah</i>". Mr. O. B. Clarke detected that a mistake had been made, and wrote on the sheet the correct name of the specimen, namely, <i>Boehmeria nivea</i>. Whether that was the identical specimen said to have been examined and named by Dr. Falconer I am unable to say, but I completely concur with Mr. Clarke's determination that that particular sheet of "<i>Pooah</i>" (which was collected no doubt by Dr. Campbell) is the typical form of rhea. But under the cover of <i>Maoutia</i> Mr. Clarke himself had named some of his own early collections of this plant as <i>Boehmeria nivea</i> and subsequently corrected them into <i>Maoutia Puya</i>. Whether this circumstance can be viewed as accounting for his having said that rhea was wild in Assam I am unable to say. But there seem no doubt that several Indian botanists made the mistake of confusing <i>Maoutia Puya</i> and <i>Boehmeria nivea</i>. The instance I have mentioned of the name having been corrected, is by no means a solitary one, in the fairly extensive series of samples that I have examined. The point is of historic value since it has a direct bearing on the story of rhea in India. I should not otherwise have regarded the correction of a name on a few sheets of herbarium specimens as of consequence. But if doubt be thrown on the determination of Dr. Campbell's "<i>Pooah</i>" which I strongly suspect must be done, then practically the entire literature of this fibre may have to be regarded as cancelled. But there are certain passages in Dr. Campbell's description that agree fairly well with <i>Maoutia</i> in fact better than with <i>Boehmeria nivea</i>, so that it may be that Dr. Campbell's description is what he saw of <i>Pooah</i> and his specimens supplied to Hergaria, may have been derived from the cultivated plant of Rungper (Conf. with para. 46).</p>		<p>Confusion Regarding Specimens.</p>
		<p>Probable Explanation of Report of Rhea being Wild. Conf. with para. 17. Rhea and Puya Confused.</p>

MAOUTIA
Pays.

Pooah.

Inferior
Quality of the
Fibre.

The examination of the fibre made by myself, on several occasions, revealed so little merit that I have been unable to understand why it had been highly extolled. But if the *Pays* of Darjeeling and Nepal which was examined and reported on by experts in Europe half a century ago, was in reality rhea and not *poi* or *guye*, then there is no difficulty in accepting the reports.

216. *Chemical Examination*.—Messrs. Cross, Bevan & King show that this fibre should be regarded as very inferior. It lost 62 per cent. by hydrolysis and contained only 32.7 per cent. of cellulose. The sample was, however, ribbons of uncleaned bark. But these chemists remark "not only was the specimen inferior in point of preparation, but it was found in the microscopic examination, impossible to isolate the ultimate fibre, by reason of its breaking up under the needles. Many of the fibres of the *Urtica* show this tendency of brittleness, but with special attention to cultivation and the conditions of growth, these defects can in all probability be removed."

217. *Re-investigation Necessary*.—As matters stand, however, I think it preferable to urge that the available information regarding this fibre is so extremely confused and imperfect, but it would be preferable were the subject re-investigated from first to last. With this object in view it may be as well if I put on record here Dr. Campbell's original communication regarding it and the report that was made on the samples. These papers may not be accessible to some of the readers of this Ledger and may accordingly be accepted as making the present sketch as complete as possible:—

Dr. Campbell's Original Report on Pooah Fibre.

218. "I have the pleasure to bring a new sort of hemp to the notice of the Society on behalf of Serjeant Grutcher, who is a professional worker in leather, and uses it in his craft. The Serjeant considers it equal to Russian hemp, for shoe and saddlery work, and purposes, if a demand shall arise for it, to prepare and supply it to the Calcutta market."

"I shall shortly describe the plant, the method of preparing the hemp with some other particulars, and will request of you to be so kind as to have it submitted to a comparative trial with the *ram* and European hems, and favour me with the result: also adding, if possible, the price it would fetch per maund in the Calcutta market."

"*Description of the Plant*.—The plant from which the hemp is made is called *Pooah* by the Parbottias, *Kimti* by the Lepchas, and *Yash* by the Limboos. It is like a nettle, and is now probably, although I cannot

Pan-Rhea.

(G. Watt.)

MAOUTIA
Puya.

determine the question. I have, however, the pleasure to submit herewith the leaves, seeds just formed, and a portion of the stem of the plant from which the genus, if not the species, may be determined. It grows to the height of 6 or 8 feet, and varies in the thickness of the stem from the size of a quill to that of the thumb. The leaf is serrated, of a dark-green colour above, silvery-white below, not hairy or stinging, and has a reddish pedicel of about 3 inches long. The seed forms in small currant-like clusters along the top of the plant, and on alternate sides about an inch apart: two small leaves spring from the stem at the centre of and above each cluster of seed."

219. "*Habitat*.—The *Pook* is not cultivated, but grows wild and abundantly in the valleys throughout the mountains of Eastern Nipal and Sikkim; at the foot of the hills skirting the Tarai to the elevation of 1,200 or 1,300 feet, and within the mountains up to 3,000 feet. It flourishes best in the hills at the same elevation to which the cotton is grown, but it does not, so far as I can learn, grow on the flat Tarai or open plain along the mountains. It is considered a hill plant, and not suited to the plains or found in them. It does not grow in the forest, but is chiefly found in open clear places; and in some situations, overruns the abandoned fields of the hill people within the elevations which suit it. It is, I believe, a perennial; but of this I cannot speak positively, as I have not till now known the plant. It sheds its leaves in the winter, throws them out in April and May, and flowers and seeds in August and September. The exact period altering of necessity with the elevation."

220. "*When used*.—It is cut down for use when the seed is formed. This is the case with the common flax in Europe. At this time the bark is most easily removed, and the produce is best. After the seed is ripe, it is not fit for use, at least it is deteriorated."

221. "*How prepared*.—As soon as the plant is cut, the bark skin is removed. This is very easily done. It is then dried in the sun for a few days: when quite dry, it is boiled with wood-ashes for 4 or 5 hours; when cold, it is beaten with a mallet on a flat stone, until it becomes rather pulpy, and all the woody portion of the bark has disappeared; then it is well washed in pure spring water and spread out to dry. After exposure for a day or two to a bright sun it is ready for use. When the finest description of hemp is wanted, the stuff after being boiled and beaten, is dashed over with wet clay and spread out to dry. When thoroughly dry, the clay is rubbed and beaten out, when the hemp is ready for spinning into thread, which is done with the common distaff."

222. "*Uses*.—The *Pook* is principally used for fishing nets, for which it is admirably adapted on account of its great strength of fibre and its extraordinary power of long resisting the effects of water. It is also used

Campbell's
Pook.
Comp. with
page 212.

MAOOTIA
Puya.

Poa-Rha.

for making game-bags, twine and ropes. It is considered well adapted for making cloth, but is not much used in this way. I have the pleasure to forward the following specimens in elucidation of this note. :—

1. Leaves of the plant.
2. Seed clusters.
3. Portions of the stem.
4. The dried bark.
5. The prepared hemp.
6. Thread.

DARJELING:
September 24th, 1847.

A. CAMPBELL.

P.S.—“In compliance with your request I forwarded to your address a packet of the *Poosh* hemp, which will, I hope, enable you to have the experiment instituted as to its comparative merits. I have also sent you a parcel of the dried bark of the *Poosh*, with which you may perhaps desire to try some other mode of preparation than that in use here.”

“Enclosed is a note from Serjeant Orutsher on the expense of preparing the hemp, which shows that the process in his hands has been very expensive. He tells me, however, that he thinks it may be prepared for about Rs 4 per maund, if done on a large scale; this of course is still conjectural. The point to be first ascertained is the quality of the article. On this I hope again to learn the opinion of the Society.”

Report by Captain A. Thomson on Dr. Campbell's Poosh Fibre.

223. “Of the *Poosh* I have to report more favourably. The substance resembles cotton-wool more than hemp, consequently better adapted, in my opinion, for sail cloth, twine, and thread than for rope. I send a specimen of the cloth, made of it, as also a piece of line. The *Poosh*, when properly dressed, is, I think, quite equal to the best Europe flax, and will produce better sail cloth than any other substance I have seen in India. I observe from Dr. Campbell's communication on this fibre, that mud is used in the preparation, which clogs it too much, and not only renders it difficult to dress and spin, but spoils the colour, as is evident by the sample of cloth made of it. My Superintendent, Mr. William Rowne, who understands the nature of these substances, tells me, that if polish were used in the preparation (which is invariably done with Russian hemp and flax) instead of clay or mud, that the colour would be improved, the substance rendered easy to dress, and not liable to so much waste in manufacturing.”

“The value of the *Poosh* fibre here may be estimated from the following data. To make one yard of sail cloth it requires 1lb 2 oz. of fibre.

M. 260-265.

Pua-Rha.

(G. Wall.)

MAOUTIA
Puya.

and the expense of dressing, spinning, and weaving it (with the rude apparatus now used by the natives), is 2 annas 6 pie, and I estimate the value of the cloth when made, at 6 to 7 annas per yard; or it may be better understood, thus:—

A maned of clean Puaah will give 75 yards	R
Less expense of manufacturing, say	25
	10
Leaving as the value of the fibre	15

"There are other incidental expenses that are not included here, but as near as I can at present estimate, I should say it is worth twelve rupees per maned. I would only further observe that, if properly prepared and dressed, I think the Puaah capable of being converted into fibres much finer than either sail cloth or sewing twine." Calcutta, 31st December 1847.

224. *Description by Mr. Gamble.*—The following article will be found of interest as supporting Dr. Campbell's description of the preparation and cleaning of the Puya fibre:—

Notes on the preparation of Puaah fibre taken from a letter by Mr. G. A. Gamble, Mungpoo, to the Superintendent, Botanic Gardens.

"The whole sample has been prepared by the method pursued by the Nepalese and Lepchas."

"The bark is peeled off the stems in long strips; boiled in water, thickened with common wood ashes until it is pulpy; then as much as possible of the adhering bark is separated from the fibre by alternately beating with a wooden mallet and washing in cold water. After this the water is rinsed out, and each bundle of fibre is thickly covered with a paste of micaceous clay, and dried. When thoroughly dry, the clay and the remaining bark are easily shaken off, leaving the fibre in a state fit for use. If fibre is required free from dust, it is repeatedly rinsed until the water runs clear, and then re-dried."

"The white or bluish white clay found here and there, near streams is preferred, as it gives the fibre a good colour."

"If the appearance of the fibre is of no consequence, yellow clay is said to be as effective."

"I do not know whether the action of the clay is altogether mechanical or not. A few samples which were prepared by treatment with lime and chalk were coarse in appearance and rough to the touch; those treated by clay, on the other hand, were soft and silky. Although the Puaah is rather a common plant, it is seldom gregarious to any extent as far as I know; so that the collection of a large quantity entails

M. 260-265.

RE
CAMBODIA
REPORT.

**MAOUTIA
Puya.**

Pun-Riba.

**MR.
GAMMIE'S
REPORT.**

an expenditure which must exceed the value of the fibre extracted. I obtained five maunds of stems, by contract, for three rupees per maund but I question if I could obtain them at the same rate again, as the people had to search far and wide for even that quantity. At a moderate estimate the further cost to manufacture the fibre was five rupees,—making a total of twenty rupees."

"The fresh stripped bark weighed 63½ and yielded only 3½ of fibre. The cost of producing one pound of fibre would therefore be ten rupees.

"*Pooah* is chiefly used for fishing nets and lines. I am told that formerly the Lepchas made cloth from it, but the contraction and expansion readily caused in it by atmospheric changes made it uncomfortable and undesirable for wearing apparel."

225. *Conclusion.*—I have no reason to doubt but that the fibre Mr. Gammie witnessed being cleaned was *Maoutia Puya*. The fibre appears to be used by the hill tribes of Nepal and Sikkim; but we know comparatively little about its chemical and physical properties. Mr. Gammie's description lends, however, considerable support to the opinion that Dr. Campbell's description at least was actually that of *Maoutia*, but there remains the unanswerable fact that the botanical specimens he sent to Calcutta as *Pooah* were those of *thea*. A further circumstance may be here mentioned. Dr. Buchanan-Hamilton was the discoverer of *Kankura* cultivation (*Boehmeria nivea*) in India and may be presumed to have taken some interest in the subject. In his *Account of the Kingdom of Nepal* (published 1811) (which embraces that of Garhwal and Kullu) he makes no mention of either *Poi* or *Kankura*.

China-Grass.

BOEHMERIA
RIVER.

APPENDIX I.

RHEA-EXTRACTING MACHINERY.

226. A Notification of the Home Department, No. 145, published on the 11th January 1870, was to the following effect :—

"The Government of India, after communication with various Agricultural and Horticultural Societies in India, and with persons interested in the subject, has arrived at the conclusion that the only real obstacle to the development of an extensive trade in the fibre of Rhea, or China-grass, is the want of suitable machinery for separating the fibre and bark from the stem, and the fibre from the bark, the cost of effecting such separation by manual labour being great.

"2. The demand for the fibre is now large, and no doubt might be extended with reduced prices, and there is a practically unlimited extent of country in India where the plant could be grown.

"3. The requirements of the case appear to be some machinery or process capable of producing, with the aid of animal, water, or steam power, a ton of fibre of a quality which shall average in value not less than £30 in the English market, at a total cost (all processes of manufacture and allowance for wear and tear included) of not more than £15 per ton, etc.

"4. To stimulate the invention or adaptation of such machinery or process, the Government of India hereby offer a prize of £5,000 for the machine and process that best fulfils all the requirements named above, etc.

"5. One year from the date of this advertisement will be allowed for the preparation of the machines and their transport to the locality named for the competition, and the trials will then be made and the decision of the judges announced. If no invention of sufficient merit is received in the above-named period to obtain the prize offered, the Government will continue to allow machines to be tendered for trial till the end of two years from the same date, after which, or on the award of the prize, the offer herein named will be withdrawn."

227. By Notification No. 45, of the 31st August 1877, the Government of India a second time made known its willingness to give a substantial award to the inventor of a process or contrivance that might be found to fulfil the specifications of a Rhea-fibre-extracting machine.

In this second notification the following passages occur :—

"Fifty thousand rupees will be paid to the inventor of the best machine or process which will separate the bark and fibre from the stem, and the fibre from the bark, of *Boehmeria nivea*.

"A smaller reward, not exceeding ten thousand rupees, will be given to the inventor of the next best machine or process, provided it is adjudged to possess merit, and to be capable, without difficulty of adaptation, to practical use.

"What is required is a machine or process capable of producing, by animal, water, or steam power, a ton of dressed fibre of a quality which shall average in value not less than £45 in the English market, at a total cost, including all processes of preparation and all needful allowance for wear and tear, of not more than £15 per ton, laid down at any port of

FIRST OFFER
OF A
REWARD.* Conf. with
p. 8.SECOND
OFFER OF A
REWARD.B. 576-606
R. 172-213.

RHEA
RIVER.

Rhea (Rhea) or

SECOND
OFFER OF A
REWARD.

shipment in India and £30 in England after payment of all charges usual in trade before goods reach the hands of the manufacturer.

"The machinery employed must be simple, strong, durable and inexpensive, and should be suitable for erection in the plantations where the rhea is grown. It must be adapted for treatment of the fresh stems as cut from the plant. The treatment of dried stems offers certain difficulties, and the fibre prepared from them must, moreover, always be somewhat more costly than the fibre produced from green stems. Except during the hot dry weather preceding the rains in Upper India, it is very difficult so to dry the stems that no fermentation or mildew shall occur. But during this season the stems are comparatively short and the crop poor and stunted, unless it is artificially irrigated, and such irrigation greatly increases the cost of cultivation. In the rainy season the plants are in fine condition, but at this season it is almost impossible to dry the stems in quantity without injuring the fibre, unless recourse is had to artificial means of desiccation, which greatly increase the cost of the material. It is therefore obvious that the attention of inventors should be given to the discovery of a process for treatment of the green stems."

* Conf. with
p. 8.

It is perhaps needless to quote the minor details of the Notification here briefly indicated. The above passages will be found to not only convey the main principles enjoined, but to deal with certain peculiarities of rhea cultivation and of the requirements of the machinery necessary for India, and these hold good to the present time. The trials were fixed to commence on the 15th September 1879.

WITH-
DRAWAL OF
REWARD.

228. The Government of India in a Resolution dated March 19th, 1881, reviewed the report of the Committee which had set to examine the machines and *withdrew the offer of any further reward*. The following passage occurs in that Resolution:—

"From the low valuation put by the English firms on the samples of fibre produced at the late competition, it does not seem probable that Indian rhea fibre will be able, for the present at least, to compete successfully with the Chinese product; while the experience which has been so far gained also points to the conclusion that *in most parts of India the cultivation of rhea cannot be undertaken with profit*. Rhea is naturally an equatorial plant, and it requires a moist air, a rich soil and plenty of water, while extremes of temperature are unfavourable to it. Such conditions may be found in parts of Burma, in Upper Assam and in some districts of Eastern and Northern Bengal, and, if rhea can be grown in such places with only so much care as is required in an ordinary well-farmed field for a rather superior crop, it is possible that it may succeed commercially. Until, however, private enterprise has shown that the cultivation of the plant can be undertaken with profit in these or other parts of the country, and that a real need has arisen for an improved method of preparing the fibre, in order to stimulate its production, *the Government of India think it inadvisable to renew the offer*, which it has now made for the second time without result, of rewards for suitable machines."

Conf. with
pp. 1, 6.

It will thus be seen that one direct result of these trials was to create a doubt as to the suitability of India as a rhea-fibre-producing country, at least on a very greatly extended scale to what is practised by the Natives in a few isolated localities. The above passages may, however, be accepted, as fully answering the question often

B. 576-606.

R. 172-213.

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All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Subjects to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually help and perfect our knowledge of Indian Agricultural and Economic matters. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain heads. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be placed according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

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NOTICE.

Future issues of this publication placed under either the "Special Veterinary" or "Special Forest Series" will not be included in the annual enumeration. The papers are printed for Departmental purposes. Their unfortunate location under the system of annual numbering has led recipients of the ordinary issues to believe their sets incomplete.

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